The Electrical Industry's Weekly Magazine December 22

1958

Electrical World

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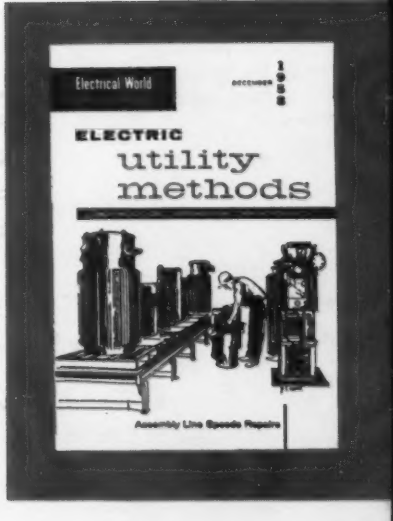


New in this issue...
Electric Utility Methods, first in a series of quarterly special reports for those charged with construction, operation, or maintenance in the fast-growing utility industry

STEVENS RICE GS
UNIVERSITY MICROFILMS
515 N 1 ST
ANN ARBOR MICH

ALLIS-CHALMERS — 25 years of 5/8% Regulator Leadership

4 steps to "Engineered Regulation"

Plan to stay ahead... MODERNIZE!

- cut revenue loss
- cut cost of regulation
- improve service

All power systems use regulation, but few realize the greatest possible benefits. That is why the "engineered regulation" approach is recommended.

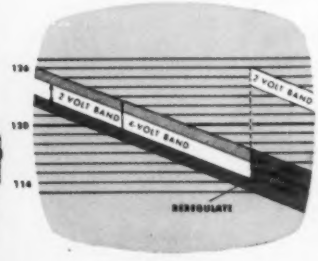
"Engineered regulation" means:

1. Use narrow 2-volt band widths.
2. Reregulate feeders.
3. Use lower cost 5/8% step regulators.
4. Utilize the complete potential of *Vari-Amp* and its short-circuit ratings so the smallest, lowest cost unit can be used at a given location.

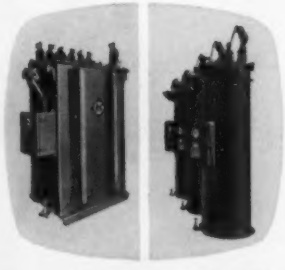
"Engineered regulation" is an art. Allis-Chalmers engineers can be of great assistance to you. Call your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.

Vari-Amp is an Allis-Chalmers trademark.

cut band width



reregulate



use low-cost units

use smaller ratings

Originators of 5/8% Step Regulators

ALLIS-CHALMERS

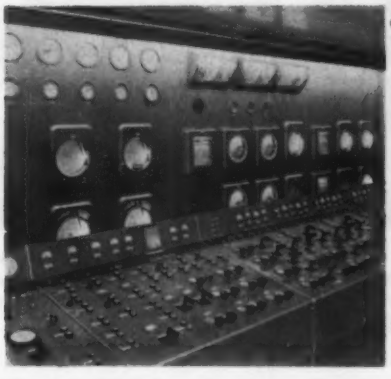
A-5859

Electrical World

Vol. 150, No. 25 DECEMBER 22, 1958

Published for 84 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

In This Week's Issue



p 45

CURRENT EVENTS

Key Issues Loom in Bustling Northwest

Flushed with victories in election, electric companies now face uncertainties from push by federal power advocates..p 36

GENERATION

Data Logging Expected to Cut Costs

S. A. Lyon, New York State Electric & Gas Corp

Automatic system at New York State E&G's Millikin station will make better use of fuel and manpower.....p 46

Brings Automatic Station Closer

Hammond Ladd, Jr, Hagan Chemicals & Controls, Inc

Automatic data handling is next step after centralized control room toward ultimate in station operation.....p 45

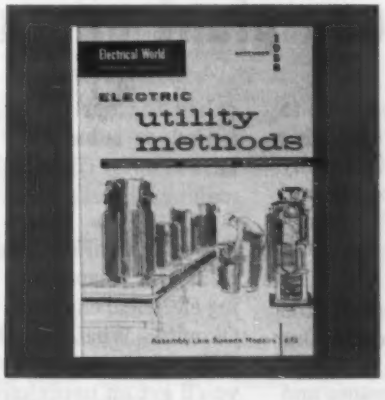
SYSTEM ENGINEERING

Analyze Loop Circuits with Digital Computer

S. H. Pollock, C. C. Taylor, Kansas City P&L Co

Preparation of data requires same time as for network analyzer, but set-up time for computer is less.....p 43

Special Report



p 57

Electric Utility Methods

With this special 68-page report, Electrical World initiates an ambitious series of quarterly reports on cost-and labor-saving techniques for utility men responsible for construction, operation, and maintenance in this fast growing industry .....p 57

Departments

Editorials 35
• Electrical Week 19
Executive Reader 22
From the Publisher 5
• Management Newsletter ...137
Manufacturers News 130
Meetings Calendar 152
New Equipment 62
Manufacturers Literature ...115
News About People.....146
Selling 145
Readers Service 125
INDEX TO ADVERTISERS...152

Soggy land and heavy reels of Okonite Cable presented a rugged installation problem. But by digging a 4-foot trench, and by "putting the Cat before the truck before the float," Guarantee Electrical Co. laid down two cables simultaneously at three miles per hour. Cables were a 15kv, 3-conductor Okolite-Okoprene submarine power cable and a 24-conductor Okolite-Okoprene submarine control cable designed to assure the continuous water supply essential to plant operation.

"We specified Okonite because...

This tough installation called for top-quality cables to assure continuous plant operation"

"Demanding assignments are 'our meat'," says Arthur Kaspar, Chief Electrical Engineer of Guarantee Electrical Company of St. Louis. "A good example is our recent cable installation for a large plant here in Missouri.

"Our client specified a never-failing, 24-hour-a-day, controlled source of plant water. The best pumping station site was miles from the plant, in low-water marsh land subject to periodic flooding from the Mississippi River—up to 25 feet above river level. One thing was certain... this called for really dependable cables for power and for control of the complex pumping station that would supply the water to the plant.

"Another thing was certain, too ... this was a job for Okonite. Our experience has taught us that Okonite gives maximum insurance and value where dependability in vital circuits is concerned."

Conferences between Mr. Kaspar and Okonite developed the proper cables: unaffected by water, highly resistant to soil conditions and other factors that attack *any* buried or submerged cable, and backed up by Okonite's 78 years of making highest-quality cable.

* * *

For your vital circuits, take a tip from Mr. Kaspar and other leading electrical engineers and specify Okonite. Whatever the installation, when you talk to Okonite you'll get an unprejudiced recommendation for your cable needs because Okonite, *and only Okonite*, makes cable by all four insulating methods: strip, dip, extrusion and taping. The Okonite Company, Passaic, New Jersey.

5248

***where there's electrical power... there's* OKONITE CABLE**

A Happy Situation

The natural gas companies can now put higher charges for gas into effect, subject to refund, while the Federal Power Commission studies their proposed increases. This is the effect of the Supreme Court ruling in the "Memphis Case." Such a decision may not mean higher gas rates in the long run but it will mean higher gas rates in the short run.

Now, about the same time that the Supreme Court delivered its decision, I ran into a statement indicating that in the past seventeen years the price of gas had increased 55% while the price of electricity had gone down 19%.

These straws in the wind have much more than passing significance to electric utilities. Two conclusions might readily be reached; first, gas will be pricing itself out of the boiler fuel market just a little faster; and second, each year gas will be less competitive as a fuel for space heating.

One thing is certain, we should stop comparing the cost of fuels as they are today and look ahead toward the mid-life span of a home to wisely choose a heating system.

Fischer Black

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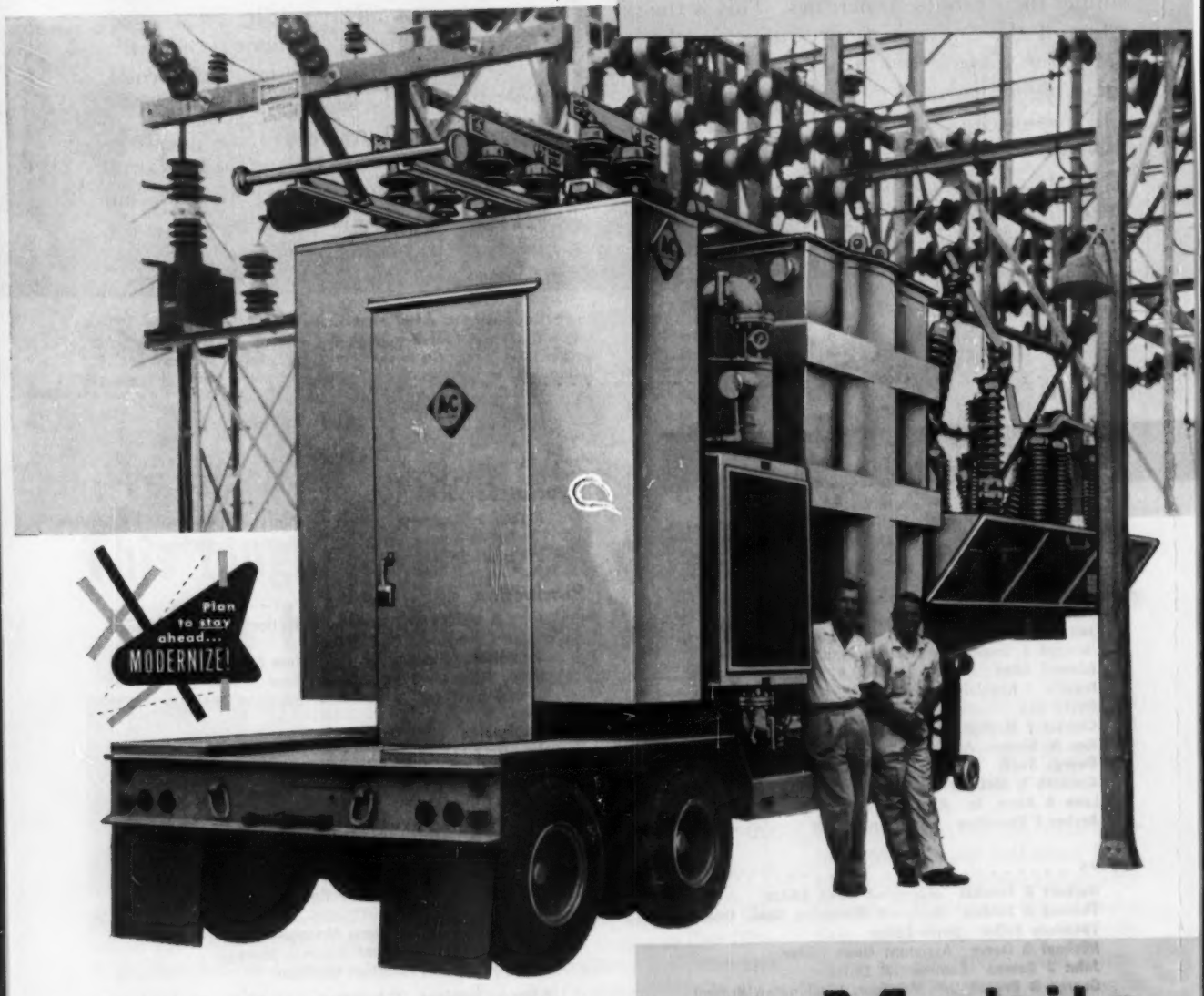
ALLIS-CHALMERS

POWER



Mobile

ALLIS-CHALMERS

on wheels

Allis-Chalmers Mobile Substations

Modern Solution to: **Power Failures**

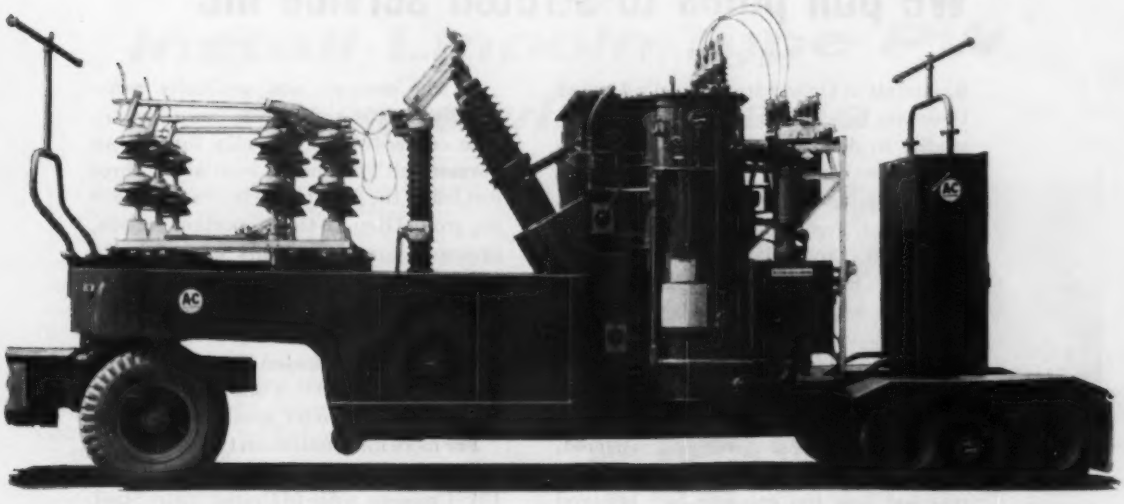
. . . Bypassing Substations

. . . Temporary Loads . . . New Loads

The mobile substation is fast becoming indispensable equipment for utilities. "Power on wheels" has not only proved its worth in quick restoration of service in emergencies, but has also proved a valuable help in maintaining everyday service continuity under circumstances which ordinarily impair or disrupt service.

The sturdy Allis-Chalmers mobile unit is a complete substation — it includes: transformer, high voltage switch, lightning arresters, fuses, and low voltage switchgear.

Call your A-C man for a detailed description of this modern mobile unit, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.



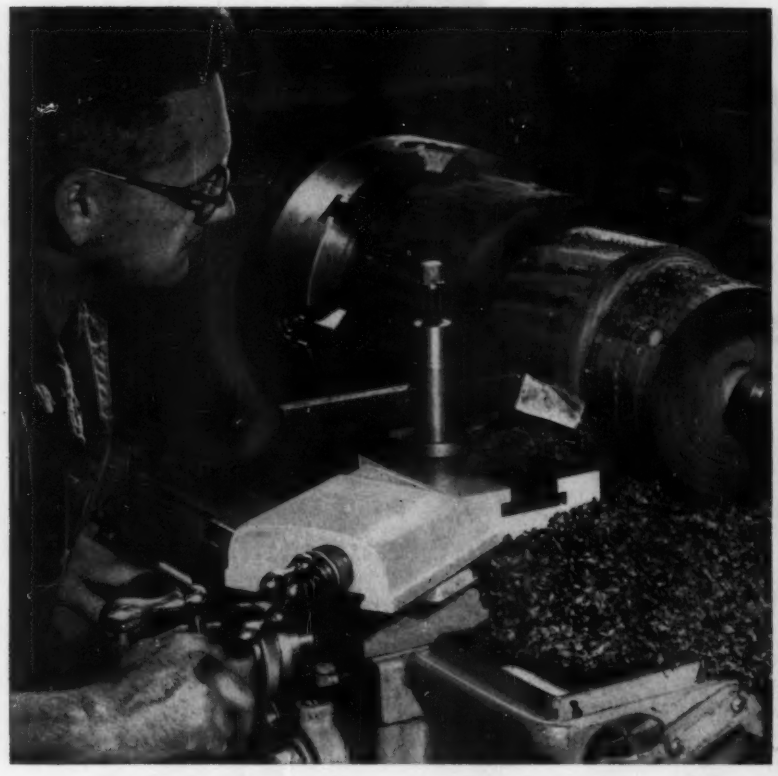
Substations

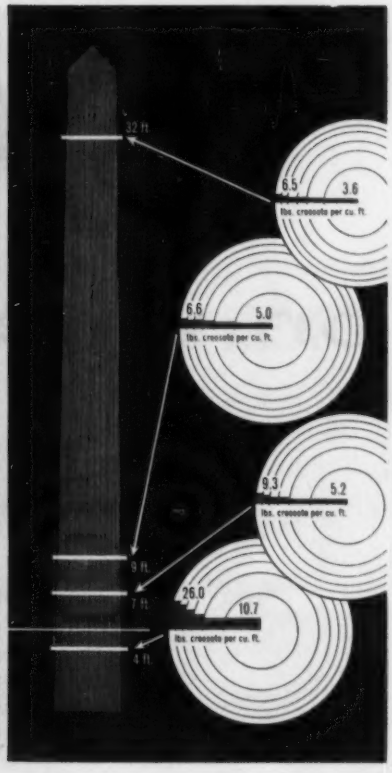
Standard basic designs are available for Allis-Chalmers mobile substations through 10,000 kva, 69 kv and below. These units may have two or three high voltages and several low voltages connectable either delta or wye.

For larger mobile substations, special design considerations may be required.

ALLIS-CHALMERS

A-5844





We pull poles to stretch service life

Scientists at United States Steel's Applied Research Laboratory conduct continuing studies to determine how and why pressure creosoting gives longer life to wood. In one experiment, a power-line pole that had been in use for 23 years was pulled from service and taken to the laboratory for study. Sections from various parts of the pole were cut out and reduced to minute shavings. Care was taken to keep the shavings from each layer of each section separate. Then, by using solvents and special extraction methods, the creosote from each batch of shavings was recovered. Analysis of the shavings from each section revealed how the creosote had behaved during service.

Results:

1. The original treatment averaged 8.6 pounds of creosote per cubic foot of wood. After 23 years, the average over-all retention was 6.6 pounds per cubic foot—more than enough creosote to ward off the heaviest attacks of termites or rot-producing fungi.

2. The creosote was gradually *redistributed* throughout the pole (see diagram). The creosote had actually formed an "armor belt" extending from about three feet below the ground line to 2½ feet above the ground line. In this important section, creosote concentrations were 3 to 20 pounds *more* than the average—and they were heaviest near the outside of the pole where protection was most needed.

3. The test indicated that a pressure-creosoted pole like this one might last for 50 to 60 years under similar conditions.

For more information on the advantages and economies of pressure treatment with USS Creosote, write to United States Steel, 525 William Penn Place, Pittsburgh 30, Pa., or call your nearest USS Chemical Sales Office in Pittsburgh, New York, Chicago, Salt Lake City or Fairfield, Alabama. *USS is a registered trademark*

USS Creosote

ACKNOWLEDGED LEADERSHIP IN DEMAND MEASUREMENT

Install Lincoln Type PW on growing loads

This new polyphase Lincoln watt demand/watt-hour combination meter is your logical choice for installations where future load growth is expected. The dual range feature permits changing the capacity of the demand element in service by simply moving two readily accessible link connections and interchanging the demand scales. Recalibration is not necessary after the changeover.

Class 100 Type PW Meters are available with dual demand ranges of 24 and 48 kw, and Class 200 with ranges of 48 and 96 kw. Meters are also available with universal scales and multiplier plates marked according to the selected range.

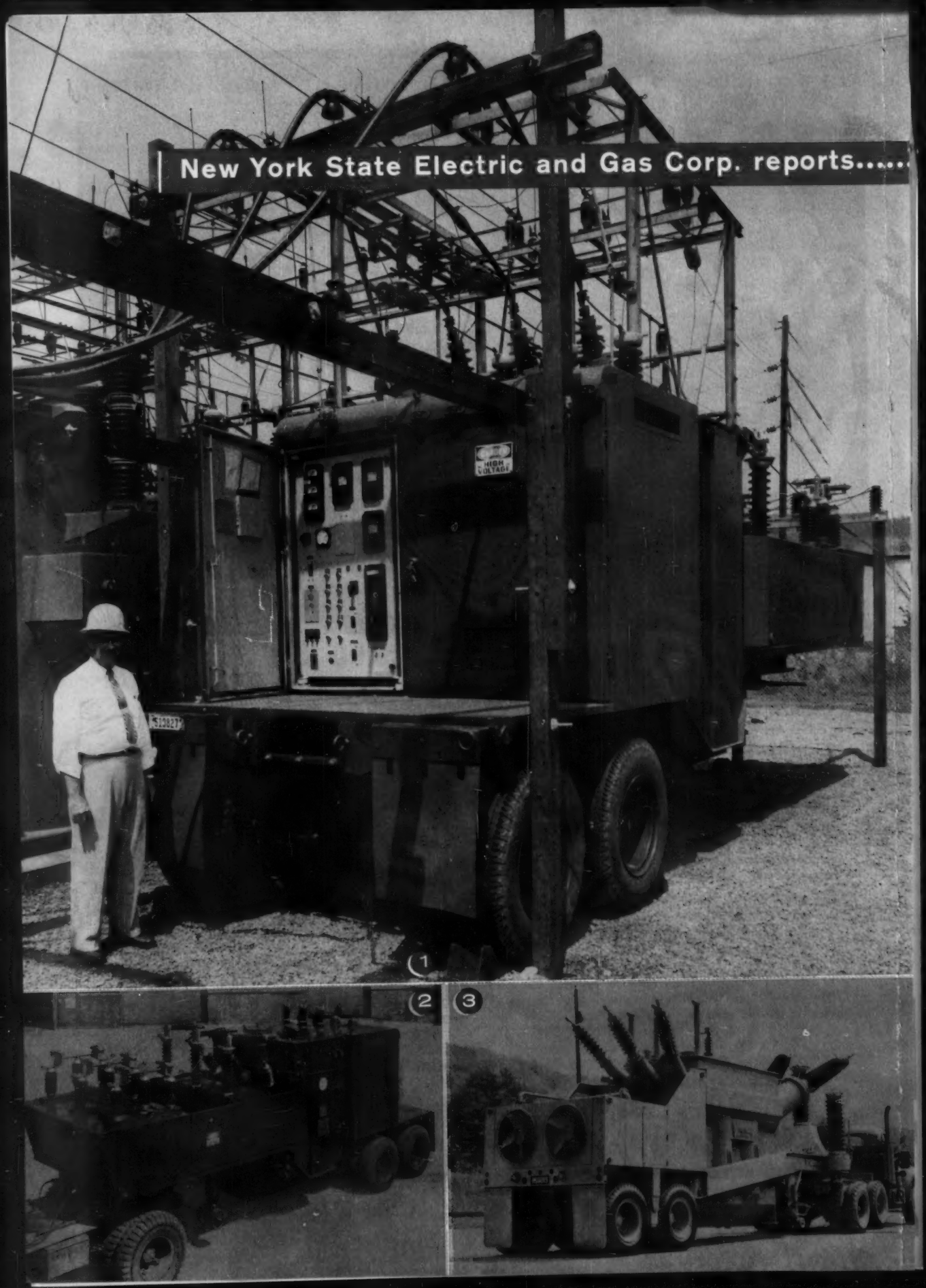
Ask your Sangamo Representative, or write for full information about the many advantages these compact, versatile Lincoln demand meters can offer.

A screwdriver is the only tool needed to change the range. Just move the links from "L" to "H" to increase range and interchange the doweled scale plate.

SANGAMO Electric Company

SPRINGFIELD, ILLINOIS

SM58-7


New York State Electric and Gas Corp. reports.....
HIGH VOLTAGE
(1)
(2)
(3)

MOBILE SUBSTATIONS

"AN ESSENTIAL TOOL" IN OPERATION OF ELECTRIC DISTRIBUTION SYSTEMS

Advantages include:

IMPROVED SERVICE TO CUSTOMERS
LOWER MAINTENANCE COSTS
SAFER WORKING CONDITIONS

An official of the New York State Electric and Gas Corporation makes the following report on his company's use of mobile substations:

"The New York State Electric and Gas Corporation has found that mobile substations are an essential tool in the operation of electric distribution systems. Modern factory-assembled mobile substations such as the 5000-kva Pennsylvania Transformer 'Transmobile' substation (shown here in service) are used to insure the least possible inconvenience to customers when service continuity is threatened by reason of the following:

1. testing and maintenance of substation transformers;

2. replacement of transformer banks to provide increased capacity or higher voltage operation;

3. alterations and/or additions to substation structures for purposes of rehabilitation or enlargement of facilities.

"In addition, there is, of course, the obvious usefulness of mobile substations for restoring service following failure of a permanent substation, and for serving temporary loads or new loads prior to the completion of permanent facilities.

"Experience has shown that the use of mobile substations for planned maintenance of equipment and alterations to substation structures gives direct benefits of lower labor costs and safe working conditions. By transferring the load to a mobile unit when work is scheduled on a permanent substation, this work can proceed during regular hours and under safe working conditions. In turn, the resulting improved working conditions will enable the crew to operate more efficiently. If a mobile substation is used where the construction of temporary facilities would otherwise have been necessary, the man-hours of labor which would have gone into the installation and removal of such temporary facilities can be used more productively."

To provide all the advantages outlined in this report by New York State Electric and Gas Corporation, a mobile substation must combine maximum substation versatility with maximum mobility and installation ease. Pennsylvania Transformer—as shown by the representative units pictured on these pages—has the experience needed to meet individual substation requirements while custom-designing to satisfy highway weight and clearance limitations.

Pennsylvania's experienced engineers will gladly work with you in determining the most efficient mobile substations for your system. Contact Pennsylvania Transformer Division, McGraw-Edison Company, P. O. Box 330, Canonsburg, Pennsylvania.

McGRAW EDISON

PENNSYLVANIA POWER TRANSFORMERS

PENNSYLVANIA TRANSFORMERS

1. At Elmira, N. Y., a Pennsylvania Transmobile Substation replaces a 5000-kva bank during installation of a new 10,000-kva unit. New York State Electric and Gas Corporation reports that mobile substations reduce costs of maintenance and alterations.

2. The same 5000-kva unit, "ready to roll."
High voltage: 34400Δ volts.
Low voltage: 2520/4360Y/2520x5040/8320Y/5040x7560/13090Y/7560 volts.
Tertiary voltage: 12600 volts.

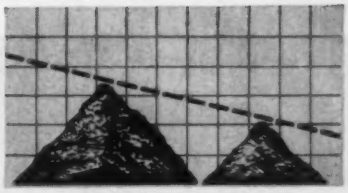
3. 15000-kva mobile autotransformer (138-69 kv) now serving a Southwestern utility. Innovations include rotatable bushings to reduce set-up time.

4. 3750-kva Pennsylvania Transmobile Substation custom-designed for an Eastern utility.
High voltage: 25700x51400Δ volts.
Low voltage: 2520/4360Y/2520x5040/8720Y/5040x7560/13090Y/7560 volts.

Now the B&W Universal Pressure Boiler is available for operation at Pressures 1800 PSI and above

How This Advance Can Help You Cut Capital, Fuel, Maintenance, and Operating Costs.

Why Lower Fuel Costs?



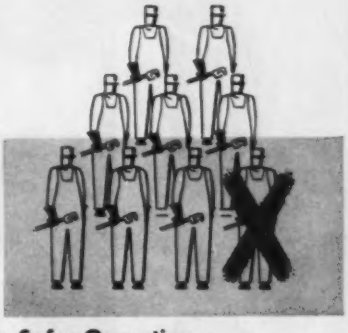
1 Through greater cycle efficiency at lower loads. The B&W Universal Pressure Boiler can be operated with constant superheater temperature down to 1/3 load. It means greater efficiency at partial loads—cuts auxiliary power requirements at lower loads.

2 Full Superheater Temperature With Multiple Fuels—Oil, Coal, Gas—or any combination.

3 No loss of time because of steam drum limitations on start-up.

4 No power required for recirculating pumps.

Why Lower Maintenance and Operating Costs?



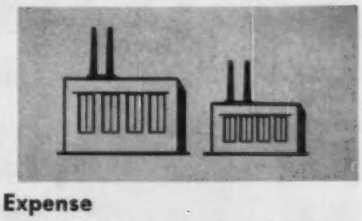
1 Because of Less Equipment to Maintain

No adjustable burner equipment for superheater control
No recirculating pumps, seals, piping
No circuit balancing valves
No gage glasses, TV, etc.
No feedwater level controls or valves
No continuous blowdown system
No high pressure chemical feed system
No drum internals to inspect and maintain

2 Because of Simpler, Safer Operation

Less safety valve maintenance
Easier and faster to clean chemically
Much less chance of damaging turbine control valves and forgings during a hot re-start
Less chance of overheating and burning out superheater tubes with high pressure feed-heater out of service
Superheater steam temperature and metal temperature do not fluctuate as much with wall cleanliness

Why Lower Capital Expense?



1 Through Less Weight and Height

Less structural steel, less building volume, massive foundations, platforms, wind-bracing

2 Through Simplified Design

3 Less Construction Expense

Shorter erection period—much more shop fabrication and pre-assembly. Better control of shipping date

PERFORMANCE PROVED

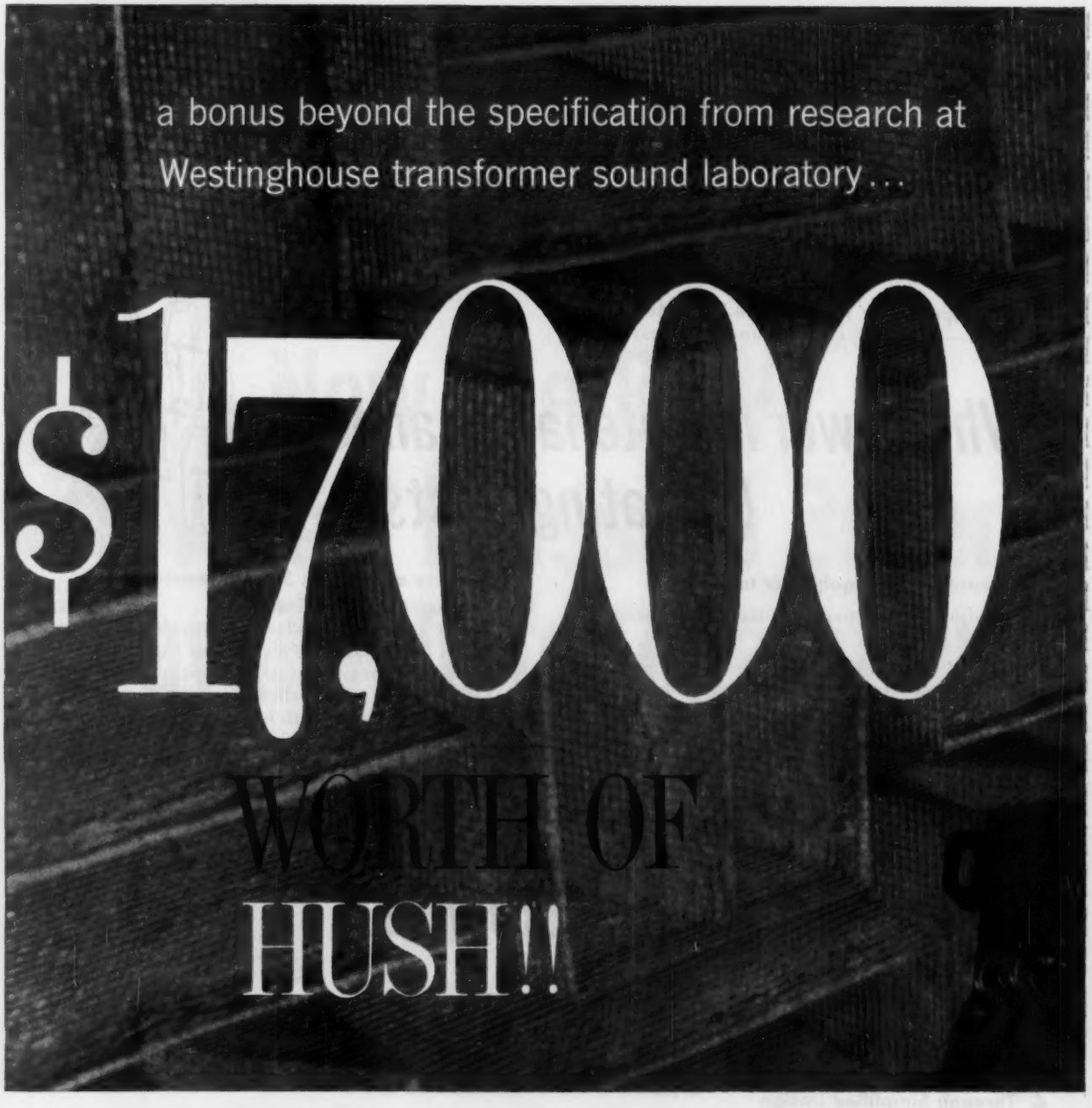
The advantages of the B&W Universal Pressure Boiler have been proved in commercial operation. The first unit of this type has had over 18 months of performance under diversified conditions. Result: Performance, ease of operation, freedom from major troubles even exceeding the optimum original expectations.

Get the full details on how the B&W Universal Pressure Boiler can bring added efficiency and economy to your operation. Write the Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

BABCOCK & WILCOX

BOILER DIVISION

G-900



New reduced sound levels for Westinghouse power transformers eliminate price premiums for many installations

Announcing reductions of power transformer sound levels from one to nine decibels below NEMA levels, Westinghouse has again demonstrated its leadership in transformer development.

This means price premiums are eliminated for transformers built to these below-NEMA sound levels—saves up to $17,000 on original transformer cost (for a 400-mva FOA transformer).

These savings were made possible through earnings plowed back into research . . . for studying and developing better means of reducing sound levels at the source—better design, new and improved methods and materials.

The major Westinghouse facility for researching sound is the vast anechoic chamber at Sharon. This laboratory—together with other high-power test equipment in Sharon's test center—permitted Westinghouse engineers to investigate sound control thoroughly . . . to evaluate sound dampeners . . . to evaluate barriers and complete enclosures . . . and to evaluate their efforts for reducing noise at its source, the transformer core.

From these test facilities came new reduced sound

levels—the result of improved materials and processing—modifications to steel formulations, handling techniques and core building combinations. The effect of each change was isolated in the sound lab, and its value thoroughly proved.

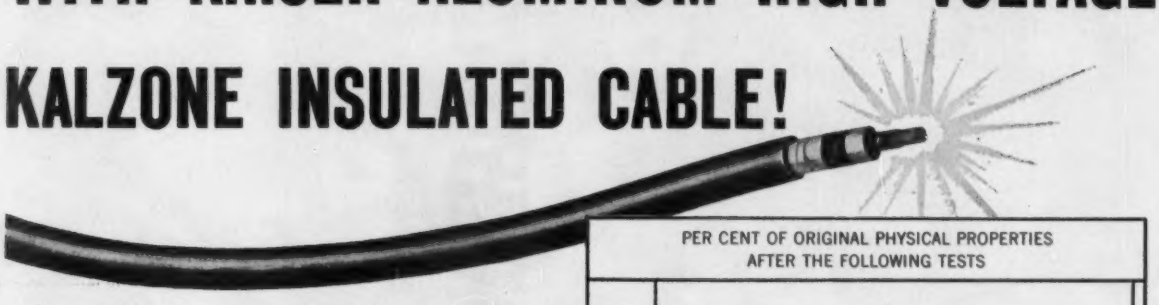
Shown here are typical examples of potential savings in transformer cost through the new reduced sound levels. Ask your Westinghouse representative about savings for your specific transformer application . . . another example of the real benefits produced through Westinghouse research—from earnings reinvested in the study of electric utility industry problems. J-70811

Typical Transformer Example	Recommended NEMA Sound Level in db	Westinghouse Sound Level in db	Reduction Guaranteed Sound Level in db	Percent Saving in Original Equipment Cost	Potential Dollar Saving on Original Cost
5000 kva Type OA 350 kv BIL or lower	67	65	2	12%	$ 3,900
10,000/12,500 kva Type OA/FA 350 kv BIL or lower	74	70	4	12%	$ 6,600
30/40/50 mva Type OA/FO/FOA 550 kv BIL	82	78	4	2%	$ 3,300
400 mva Type FOA 900 kv BIL	96	89	7	2%	$17,600

YOU CAN BE SURE...IF IT'S Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV MONDAYS

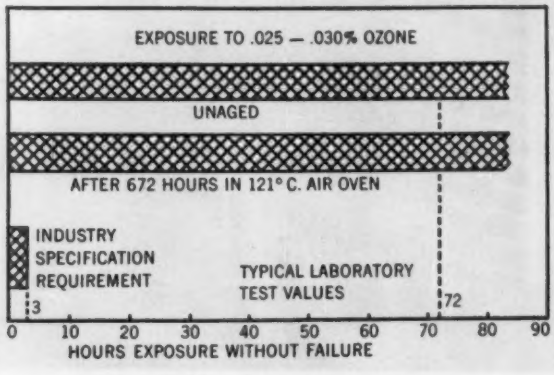
10 TIMES MORE INSULATION RESISTANCE WITH KAISER ALUMINUM HIGH VOLTAGE KALZONE INSULATED CABLE!

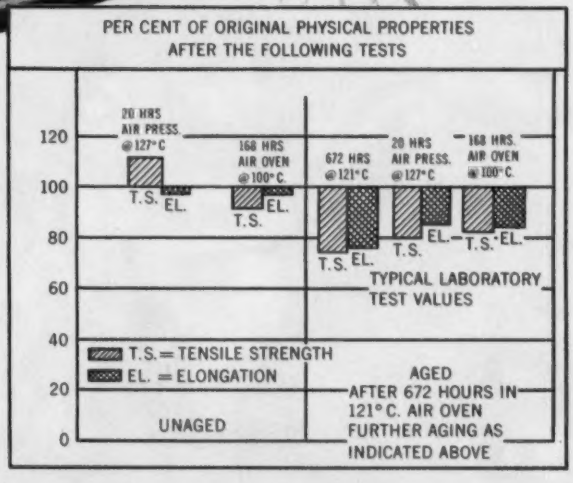


A year-long analysis of 393 full-length reels of Kaiser Aluminum Kalzone insulated cable showed that more than 93% of the lengths tested exceeded an insulation resistance constant "K" of 100,000 . . . ten times greater than current IPCEA requirements of 10,000!

More than 5% of the balance tested exceeded a 50,000 "K," and ¾ of 1% fell between 25,000 and 50,000.

Laboratory tests prove Kalzone provides best protection against ozone, heat, moisture


EXPOSURE TO .025 — .030% OZONE
UNAGED
AFTER 672 HOURS IN 121° C. AIR OVEN
INDUSTRY SPECIFICATION REQUIREMENT
TYPICAL LABORATORY TEST VALUES
3
72
0 10 20 30 40 50 60 70 80 90
HOURS EXPOSURE WITHOUT FAILURE



OZONE RESISTANCE

Unaged—Withstands more than 72 hours in .025–.030% ozone without failure.

Aged—Still withstands more than 72 hours in .025–.030% ozone without failure after 672 hours in a 121° C. Air Oven.

HEAT RESISTANCE

Unaged—Practically unaffected by Air Pressure or Air Oven Tests.

Aged—Actually improves in per cent of original tensile strength and elongation in Air Pressure and Air Oven Tests, after 672 hours in 121° C. Air Oven.

MOISTURE RESISTANCE

MECHANICAL

Unaged—Less than 5 milligrams absorption in standard Gravimetric 7-day Test. (IPCEA, 15 mgms.)

Aged—After 672 hours in a 121° C. Air Oven, less than 7 milligrams absorption.

ELECTRICAL

Unaged—Less than 2% increase in Capacity in 1–14 day EM-60 Test. (IPCEA, 5%.)

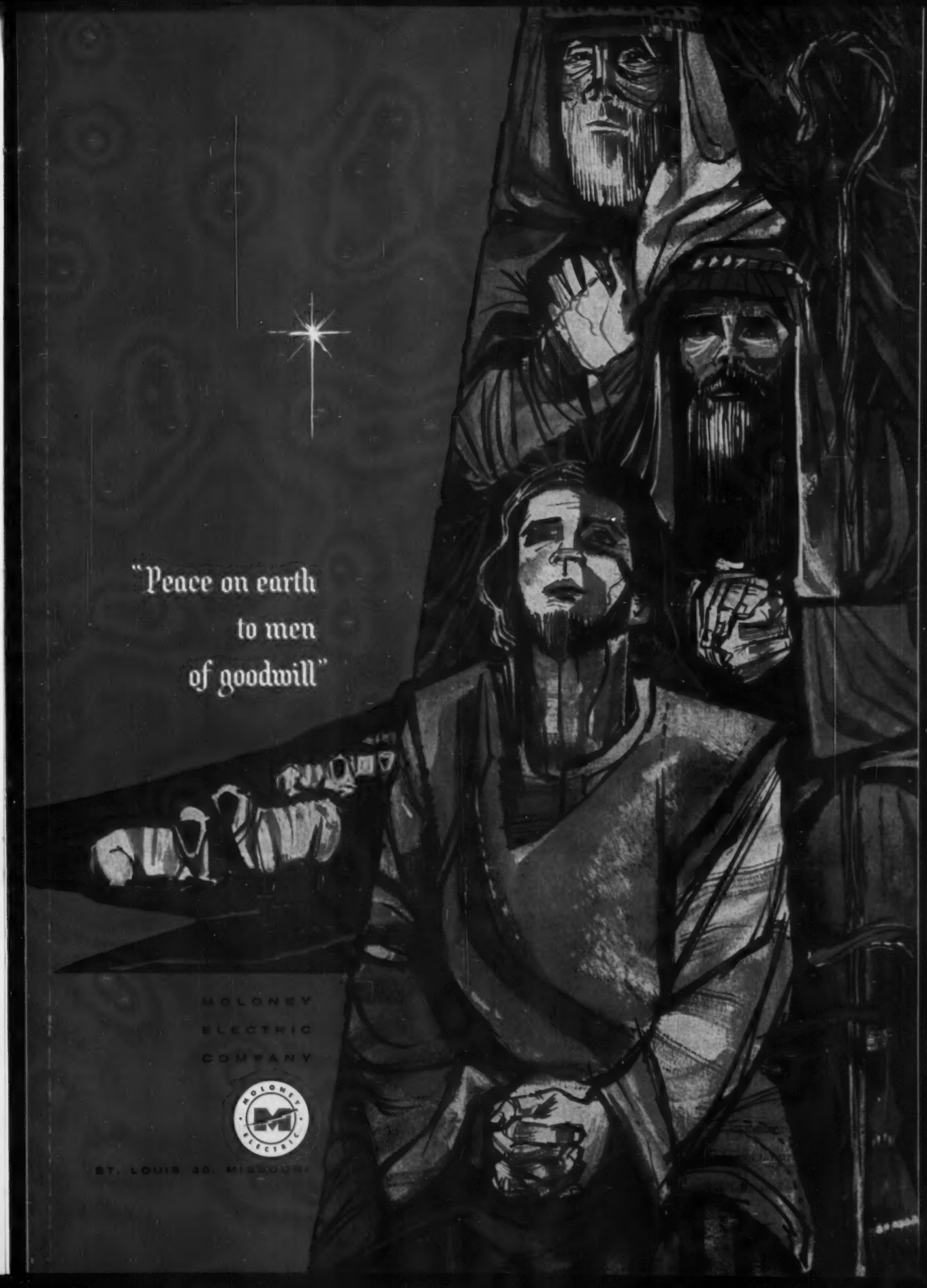
Aged—After 672 hours in a 121° C. Air Oven, less than ½ of 1% increase in capacity in 1–14 day EM-60 Test.

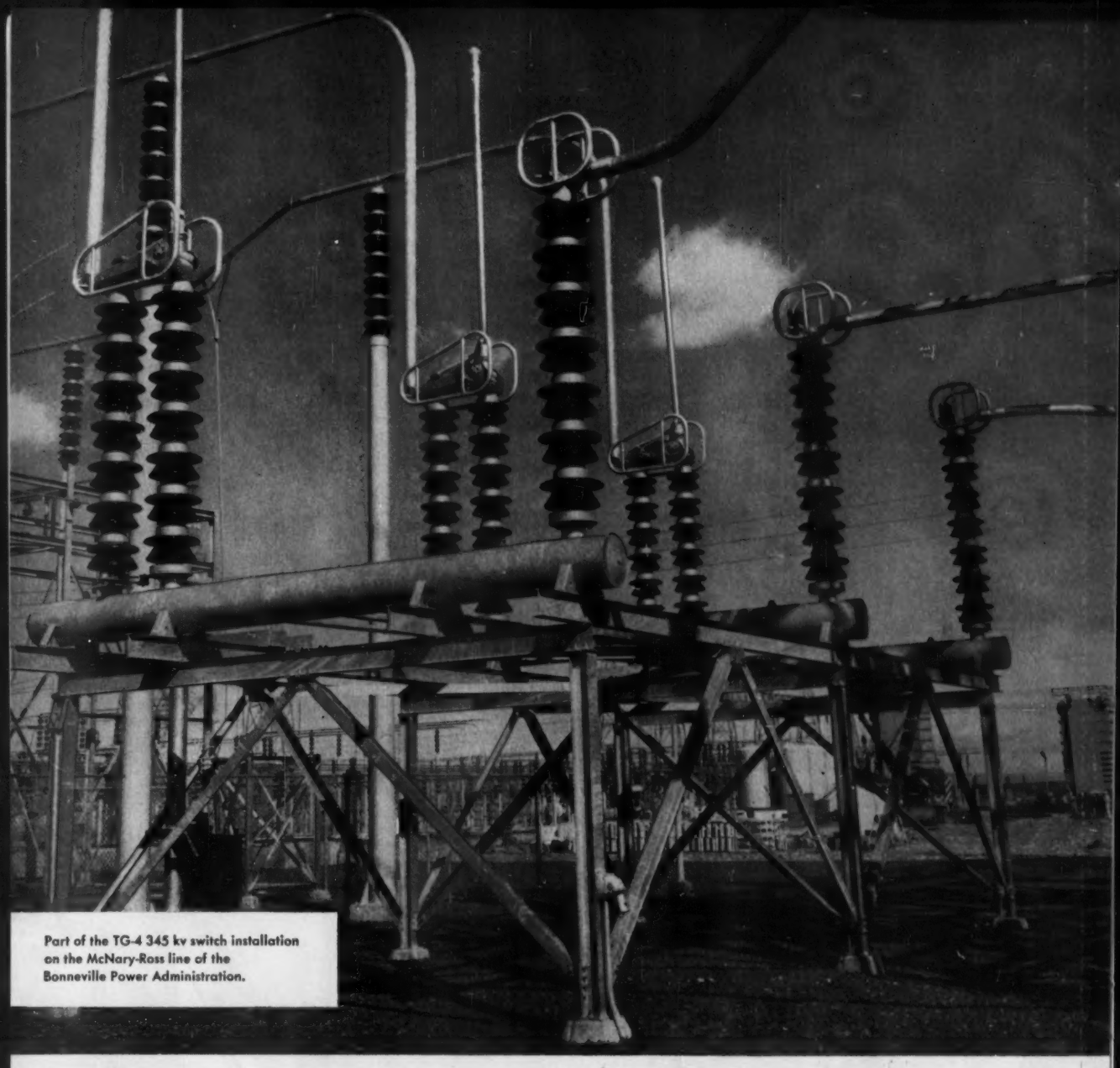
Kaiser Aluminum Kalzone insulated high voltage cable is laboratory tested and quality controlled during actual production to assure *proved quality* with every reel. Get full details on this low cost, lightweight aluminum power cable now. Contact the Kaiser Aluminum sales office listed in your telephone directory.

Kaiser Aluminum & Chemical Sales, Inc., 919 N. Michigan Avenue, Chicago 11, Illinois.

KAISER ALUMINUM

IF IT CARRIES CURRENT, K/A CARRIES IT!


"Peace on earth
to men
of goodwill"
MOLONEY
ELECTRIC
COMPANY
MOLONEY
ELECTRIC
ST. LOUIS 20, MISSOURI



Part of the TG-4 345 kv switch installation on the McNary-Ross line of the Bonneville Power Administration.

FROM AIR SWITCHES TO COMPLETE SUBSTATIONS A DEPENDABLE SINGLE-SOURCE FOR ALL YOUR SWITCHGEAR REQUIREMENTS

Federal Pacific TG-4 air switches (illustrated above), were among the first in this country to go into service at 345 kv. Providing consistently safe, trouble-free operation, these extra-high-voltage switches demonstrate the switchgear design leadership Federal Pacific offers you.

Of advanced, simplified design, the TG-4 is available in BIL ratings from 1300 to 1800 kv, 1600 amp continuous current and 70,000 amp momentary current ratings to meet the ever-accelerating trend toward higher and higher voltages.

Whatever your needs—switchboards, low voltage metal-enclosed, medium voltage metal-clad, unit substations, power circuit breakers, power switching equipment or complete substations—you can depend upon Federal Pacific for quality switchgear. For further information write Department APR, Federal Pacific Electric Company, 50 Paris Street, Newark 1, N. J.

FEDERAL FPE PACIFIC

Better Products to Control Electricity

The Electrical Week

LATE NEWS ▶ **Washington notes** . . . Interior Undersecretary Bennett again calls for partnership development of California's Trinity River, but doesn't expect White House to include anything in budget for it . . . AEC will probably accept the bid of 54 private utilities to build a gas-cooled reactor.

Calder Hall's fourth and last reactor goes critical. It will undergo tests in the next few months while working up to full power.

Indiana & Michigan Electric and Utility Workers of America agree on a 5% wage hike at the company's Tanners Creek Station.

The five leading contestants for EEI's Edison Award (former GE Coffin Award) are: Alabama Power, Arizona Public Service, Idaho Power, Pacific Gas & Electric, and Philadelphia Electric Co.

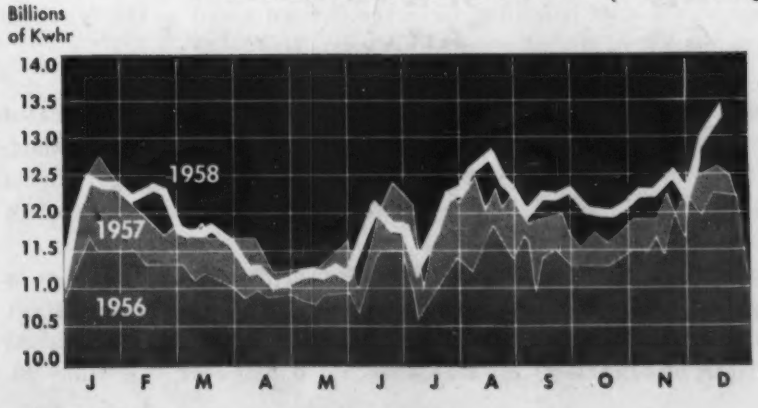
AEC establishes reactor supervisory training program at Shippingport. First class starts Jan. 5. Tuition: $2,000 per student.

Paducah, Ky., City officials and Kentucky Utilities plan to meet to discuss possible sale of KU's properties to that city.

Second Power Progress Dinner (PIP) will be held at Hampshire House, New York City on Feb. 5, 1959.

Management changes . . . E. S. Harrison, chief mechanical and hydraulic engineer for Georgia Power, is named vp and chief engineer for Southern Services . . . Georgia Power names E. J. Archbold chief engineer . . . W. K. Harding is new Duke Power Co transmission engineer . . . R. F. Stuart becomes general superintendent of substations for Pacific G&E . . . Anaconda Wire & Cable appoints W. L. Grey to newly created post of vp and general counsel . . . L. M. Currie becomes vp of Babcox & Wilcox Co.

POWER OUTPUT—UP 7.0% (Week ending Dec. 13), Kwhr 13,450,000,000



Per Cent Change From Previous Year

	Nov. 29	Dec. 6	Dec. 13
Total U. S. ...	+5.7	+5.7	+7.0
New Eng.	+9.5	+8.9	+9.6
Mid. Atlantic..	+4.0	+6.1	+6.4
Cent. Ind.	+6.1	+6.2	+7.7
West Cent.	+7.0	+7.6	+9.4
Southeast	+4.1	+4.0	+5.1
South Cent.	+8.2	+6.9	+8.3
Rocky Mount...	+5.6	+6.7	+7.6
Pacific			
NW	+4.5	+3.5	+7.3
SW	+7.9	+5.2	+6.3

Seasonally Adjusted Index 246.0
Week Ago 242.0 Year Ago 230.3

Source: Edison Electric Institute

A TWO-MINUTE PREVIEW OF THIS ISSUE

EVENTS ▶ **The hassle over the Columbia River Development Corp continues** as businessmen, farmers and private utilities call Sen Neuberger's bill a "thinly disguised CVA" at hearings in the four states covered by the bill. Private utilitymen voice strong objections to a corporation that would be "wholly unregulated, and able to gain an economic stranglehold on the Northwest." (p 36).

AEC gave a tentative go-ahead to Power Reactor Development Co to build a fast breeder reactor at Lagoona Beach, Mich. Although three commissioners approved the license, it is nevertheless an intermediate decision just as though an examiner has issued it. Parties have 20 days to file exceptions; if none are received, the order is final (p 40).

JCAE plans a study of radioactive waste disposal in late January and early February. Five days of hearings are scheduled, and they will be as thorough as the '57 inquiry into radioactive fallout, according to joint committee Chairman Chet Hollifeld (p 40).

SYSTEM ENGINEERING ▶ **Loop circuits are analyzed faster and more accurately** on a digital computer than on a network analyzer, say the authors of this week's lead system engineering story. In this case, a small Electrodata 101 computer was used, but programming for any computer could be developed readily. Answers are printed, and include watts and vars in each line section, voltage at each load point, and total losses in the loop. Check points are also "programmed in." Details on p 43.

GENERATION ▶ **Logging generating station data automatically will mean savings** in time, manpower and energy production costs at New York State E&G's Milliken Station. The new information-collecting system will be used with the existing 150-Mw unit as well as a new one going in. It is expected to eliminate keeping manual log sheets as well as routine checking of auxiliary bearing temperatures (p 46).

Automatic data handling brings the automatic generating station closer. But in doing so, it also brings new problems, the principal one of which is that the centralized control room, a necessary adjunct to automatic data handling, lacks the desired speed in the accurate interpretation of voluminous complex data (p 45).

TRANSMISSION ▶ **Bundled conductors save weight on 110-kv bus.** Bundled conductor bus, made up of two 1,590-MCM all-aluminum cables per phase, has been installed at a 110-kv generating plant substation of Alabama Power Co. It saved weight, thus saving on structural supports (p 54).

SPECIAL REPORT: ELECTRIC UTILITY METHODS ▶ **The most comprehensive special report ever published by EW is in** this issue. Called "Electric Utility Methods", the 68-page report covers construction, operation and maintenance. It will be published quarterly during 1959 on the following dates: Mar. 30, June 29,

Sept. 28, and Dec. 21. In addition to feature articles and stories in the three areas mentioned above, EUM will also cover developments in new equipment, safety, stores and publications. The stories will be based on our "How To" articles, that is, they will be short, clearly written and heavily illustrated. A readers service is also included (p 57).

Here's a brief rundown on important articles in the first EUM:

About 800 transformers a month are being processed in Commonwealth Edison Co's repair shops. A conveyor belt and monorails speed up repair operations (p 73).

Aligning a turbine-generator shaft while it is running is a smooth operation at Union Electric. Levels and micrometer gauges are used to pull off the trick (p 76).

Divers are being used to inspect submarine cable in Jacksonville, Fla. Periodic checks help forstall repairs, corrosion, attrition and extend the useful life of submarine equipment (p 79).

MANAGEMENT ▶ **Reversal of the "Memphis decision" was welcomed** by the utility industry, although its direct effects on electric companies were expected to be small. Gas expansion and some further price hikes were expected, but the most general reaction was one of relief that a dangerous regulatory precedent had been struck down (p 137) . . . Utility employees want more information on industry problems such as A-power development and "preference." Here's a survey of their present knowledge and opinions (p 138).

MANUFACTURERS ▶ **General Electric dedicated a new Lamp Research Center** at Nela Park, Cleveland. The multi-million dollar facility will house three laboratories: (1) A Lamp Research Lab; (2) A Lamp Engineering Research Lab; and (3) A Radiant Energy Effects Lab . . . Highlights of the 23rd National Exposition of Power and Mechanical Engineering on p 130 . . . McGraw-Edison's Pennsylvania Transformer Division has a 3-phase load-tap transformer which provides individually controlled voltage regulation for each phase (p 134).

SELLING ▶ **Cold weather provides a chance for some unusual applications** of electrical energy on the farm and in the home. A portable slab brooder gives chicks sufficient warmth in all kinds of weather on a North Carolina farm . . . Electric heating cables is the easy answer to the problem of keeping driveways and sidewalks free of snow and ice. Both stories on p 145.

PEOPLE ▶ **B. J. Dorsey has been elected vp at Virginia Electric & Power Co,** effective Jan. 1 . . . New chief engineer of Public Service Co of Indiana is Harold Goldberg . . . W. R. Heath is the new president of Buffalo Forge Co (p 146).

Are the right people in the right jobs? What are we doing to help them prepare for better jobs? How can we get people with potential abilities and willingness to develop and use these potentialities? There is no more important personnel function today than a critical appraisal of selection procedures and training programs. **DeWitt Pike, EEI Bulletin, Nov 1958.**

TECHNICAL NOTES

Computer solution of the economic dispatch problem depends on the accuracy of the data used for economic dispatch, whether the computer will be under the control of engineering, load dispatching, or load forecasting personnel, and the cost of the computer.

A two-conductor bundle horizontally spaced offers a greater chance for conductors to cling together due to wind action or short circuit. This configuration with 16-in. spacing needs a minimum of three spacers per 550-yd span.

Unpleasant consequences of newly-discovered phenomena of mercury-arc rectifiers operating at high voltage in parallel were stopped by suppressing the high-frequency oscillations that arose upon ignition.

Use of higher steam pressures in nuclear power plants would lead to improved heat rates and lower power costs. However, as long as saturated steam is used, there is little incentive to go to higher pressures. The gain in heat rate does not justify the increased equipment costs.

Severe mechanical stresses are set up in arresters base-mounted on transformer tanks as a result of vibrations during fault conditions.

FROM EDITORS IN THE FIELD

Old oil from transformers and breakers is used to start boilers in the power plants of West Penn Power Co.

Ceramic sponges for disposal of liquid radioactive wastes show "considerable promise," says the health division of University of California's Los Alamos Scientific Lab. After several soak-dry cycles, the clay sponges are fired at about 1300C to chemically fix the radionuclides. One problem is treatment of off-gases from drying and firing.

NAME IT

...and you can have it!

You can get O-B Insulation on new switches and package substations *if you ask for it*— your own records will justify the slight trouble

Some people think all switch and bus insulators are alike. *Do your own records say this?*

You can find out, in your own office, from information gathered on your own terms, and free from all salesmen's claims, just how *unlike* switch and bus insulators may be. You can tell when they were installed, what replacements, if any, have been made, and why.

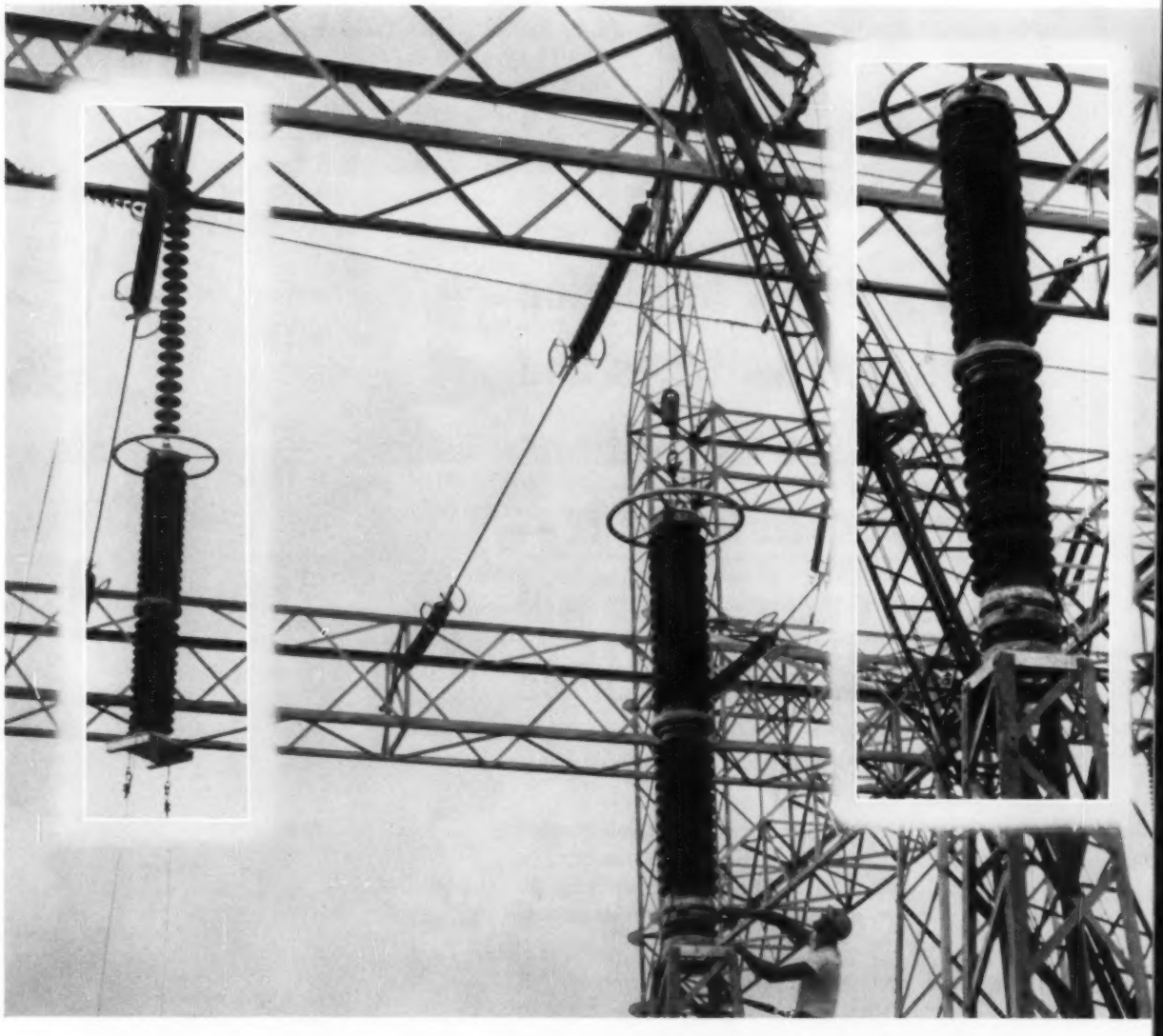
If your experience is typical, you will discover that O-B insulators have consistently out-lived others. Since prices are similar, this means you got better mileage on your invested capital. You also saved the time, cost, and inconvenience of repair work.

Switchgear and package substation manufacturers don't know what insulator you prefer *until you name it.* Specify O-B. Your own records will justify this small extra trouble.

OHIO BRASS COMPANY, MANSFIELD, OHIO
Canadian Ohio Brass Co., Ltd., Niagara Falls, Ont.

Ohio Brass

PUT THEM



Proof of Thorex flexibility. One 345-kv arrester pole is suspended from a station cross-member without any special provisions, due to its light weight. The other two poles "double" for station insulator stacks in stabilizing flexible jumper loops and are, therefore, mounted on regular pedestals. Shipped, handled, and installed in one piece; their erection time is almost negligible. With these unique advantages, the new Thorex Dynagap ushers-in a whole new order of surge durability, contamination resistance, high protective ability, and construction convenience.

ANYWHERE CHEAPLY!

O-B THOREX DYNAGAP LIGHTNING ARRESTERS

COMBINE TODAY'S BEST PROTECTION WITH...

small size
light weight
construction flexibility
lowest installed cost

- Only 9½ feet tall and 1050 pounds *for a complete 345-kv lightning arrester* . . . Lower voltage models are much smaller, much lighter.
- From shipping crate to final position in a minute or two.
- Manufactured, packed, handled, and erected in one single piece.
- Supported on a plain pedestal or suspended from station steelwork, with no special provisions.

Put your own value on time, material, and space saving. It will probably go a long way toward paying for the arrester.

All this convenience--all these economies --come to you in addition to a totally new order of equipment protection and contamination resistance.

See what really modern design has brought to the high voltage lightning arrester art. Investigate the new Thorex Dynagap Type MPR for voltages 92 kv and above. And remember, identical parts and comparable performance will be found in all other Dynagap models down to 3 kv.

OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass

STRENGTH

of the RIGHT kind... in the RIGHT place

Bushings work for you this way ↗, but they travel and arrive on the job this way →. Design adequate for this position ↗ may not be enough for this →.

Shocks beyond the line of duty can cause radial displacement of bushing parts. Roads, concrete or steel, may have bumps. Freight handlers may be a bit butter-fingered.

These extra demands--demands separate from conventional operating requirements--have been anticipated in O-B bushing design.

Massive coil springs, imposing uniform axial force over considerable amplitude of movement, maintain rigid assembly to meet all predictable demands. For the *un*-predictable cases, they provide proper yield and complete recovery. Gasket materials are specially selected to avoid a "slippery" joint. Metal surfaces are machined to trap these gaskets and gain added mechanical strength.

Ability to arrive on the job with their superior qualities intact has been carefully engineered into O-B bushings. And they are easy to get without any price premium. Simply *ask for them* on your new station apparatus.

OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass

Naugatuck PARACRIL OZO

The oil-resistant, ozone-resistant nitrile rubber

Now! lasting **COLORS** in rubber wire jackets

A development of Naugatuck research makes it possible to combine in a vulcanized rubber wire jacket all these properties:

- Excellent resistance to ozone and outdoor "weathering"
- Outstanding heat resistance
- High abrasion resistance
- Excellent oil, grease and chemical resistance
- Fast CV extrusion

...PLUS PERMANENT BRIGHT COLORS

In addition to the suggested uses, you will think of dozens of other applications where wire jacketing with all these properties can serve either an aesthetic or utilitarian purpose.

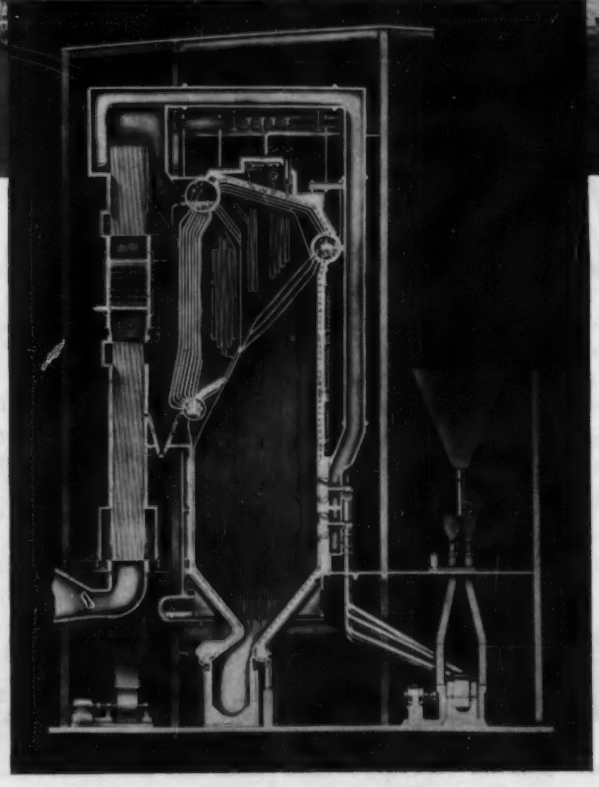
One of Naugatuck's technical representatives will be happy to discuss with any prospective user the formulation of the Paracril® Ozo compound which makes possible this combination of properties... not only in wire jacketing but also in shoe soles, hose jackets, weather stripping and other vulcanized rubber products.

Naugatuck Chemical

Division of United States Rubber Company

1213P Elm Street
Naugatuck, Connecticut

Rubber Chemicals • Synthetic Rubber • Plastics • Agricultural Chemicals • Reclaimed Rubber • Latices • CANADA: Naugatuck Chemicals Division, Dominion Rubber Co., Ltd., Elmira, Ontario • CABLE: Rubexport, N.Y.



Riverton Station
Northern Virginia
Power Company
Riverton, Virginia

Sanderson & Porter
Engineers

A survey of your plant by a qualified consulting engineer could show ways of making surprising savings in your power costs.

A Dramatic Record Of Availability At Riverton Station

Riley Steam Generating Unit gives eight years of efficient service with but ONE forced outage

Engineers of Northern Virginia Power were so impressed with the availability factor of this Riley boiler that they voluntarily advised us that since November 1950 there has been but one short forced outage, making it the best boiler in the entire system from a service standpoint.

Here is a record of performance that is proof of dependability and one of the reasons why so many public utility companies have swung to Riley in the past ten years. This boiler operates at 875 psig and 900 F. and is fired by Riley pulverizers and burners.

Today, Riley designs incorporate outstanding characteristics which meet the exacting requirements of the modern power plant. We are confident that it will pay you to investigate modern Riley designs when you are considering the installation of additional steam generating equipment. Riley engineers will gladly call on you.

RILEY STOKER CORPORATION, WORCESTER, MASSACHUSETTS

RILEY

STEAM GENERATING & FUEL BURNING EQUIPMENT

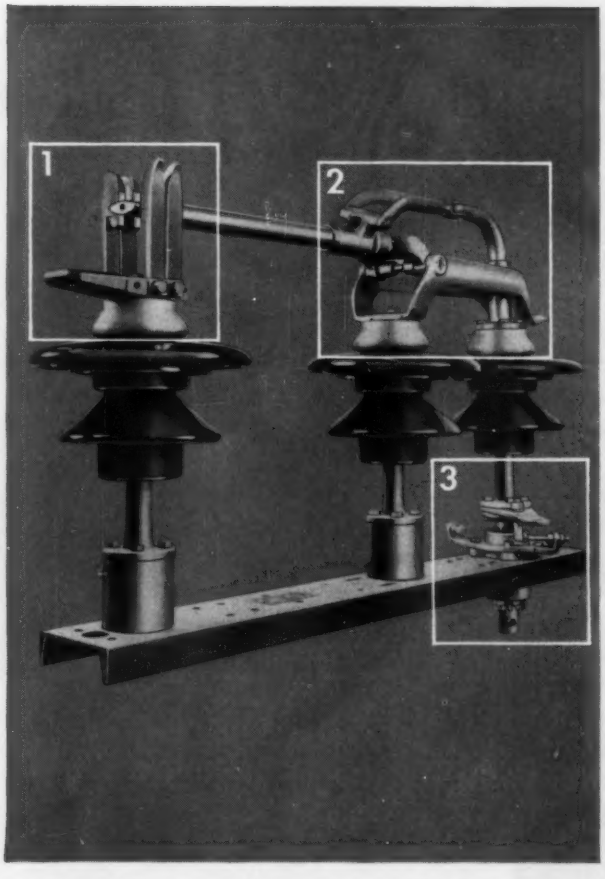
Sales Offices

Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Jacksonville, Kansas City, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Salt Lake City, San Francisco, Seattle, St. Louis, St. Paul, Syracuse, Worcester.

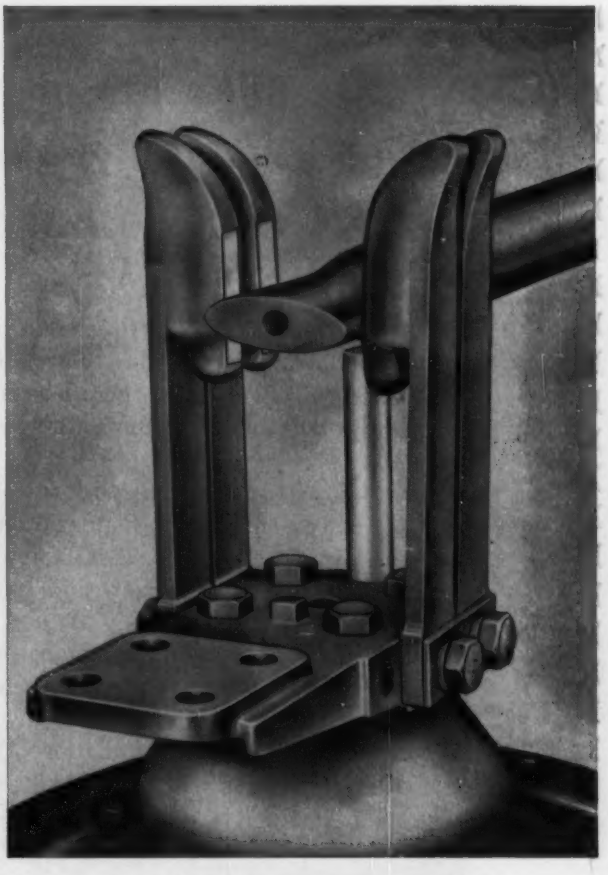
R&IE OUTDOOR DISCONNECTING SWITCHES

EASY TEST FOR

Look for these design features . . . they explain why



Look for rounded contours on all parts and liberal spacing between parts having relative motion. R&IE switches, designed this way, can be actuated under severe icing conditions with surprising ease. Other switches, with complicated or closely packed mechanisms, are generally handicapped by relatively thin ice coatings, locked by heavier ones.

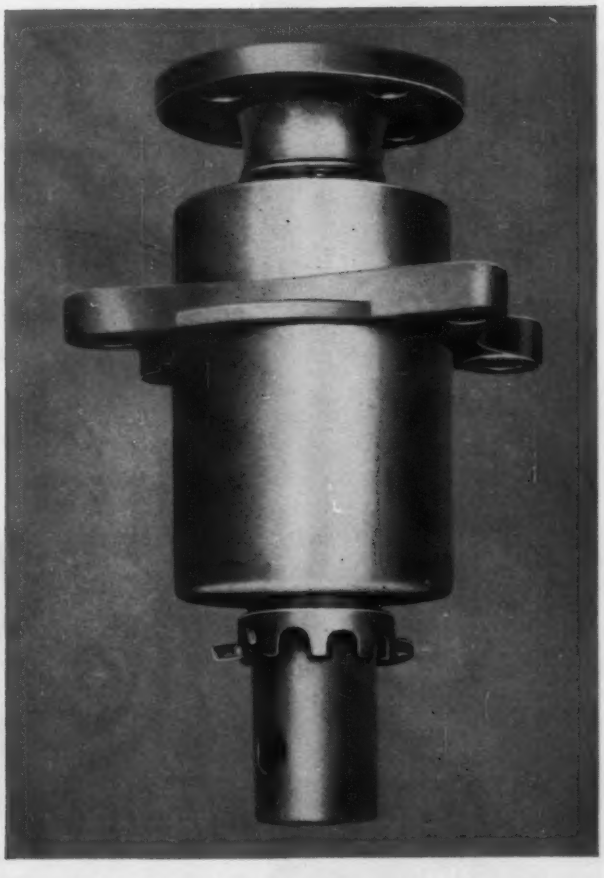


1 Look for a heavy copper jaw with silver-to-copper contacts. Thus constructed, R&IE switches show no evidence of overheating when tested well above their short-time current ratings. R&IE avoids the use of thin stamped jaws, which lack thermal capacity, often burn or erode under overload or fault currents . . . requiring more frequent maintenance.

Compare R&IE switches, point by point, with others. Discover the extra assurances of better performance, which you get at no extra cost. Available in ratings from 7.5 to 345 kv and from 400 to 6000 amp. For complete information, ask your nearby I-T-E sales office for a copy of Bulletin 1342-A. Or write R&IE Equipment Division, Greensburg, Pa. In Canada: Eastern Power Devices Ltd., Port Credit, Ont.

BETTER SWITCH DESIGN

you can expect better performance from R&IE switches



2 Look for sealed hinge-end contacts. R&IE switches have weather-sealed contacts at the hinge end for continuous low-resistance current transfer. Exposed hinge-end contacts are vulnerable to ice locking and, when corroded, lower short circuit capacity. Look also for only nonferrous exposed live switch parts . . . an R&IE feature which assures long switch life.

3 Look for a sealed, greaseless switch bearing. This part transmits turning force from the operating crank to the switch actuating mechanism. The R&IE switch bearing, sealed against moisture and foreign matter, is not affected by low temperature and requires no lubrication. Unsealed bearings are subject to fouling by ice and dirt, making switch actuation difficult or impossible.

I-T-E CIRCUIT BREAKER COMPANY
R & I E EQUIPMENT DIVISION • GREENSBURG, PA.

NEW UTILITY STATIONS, C-E EQUIPPED

Includes only new stations on new sites placed in operation since JANUARY 1, 1950.

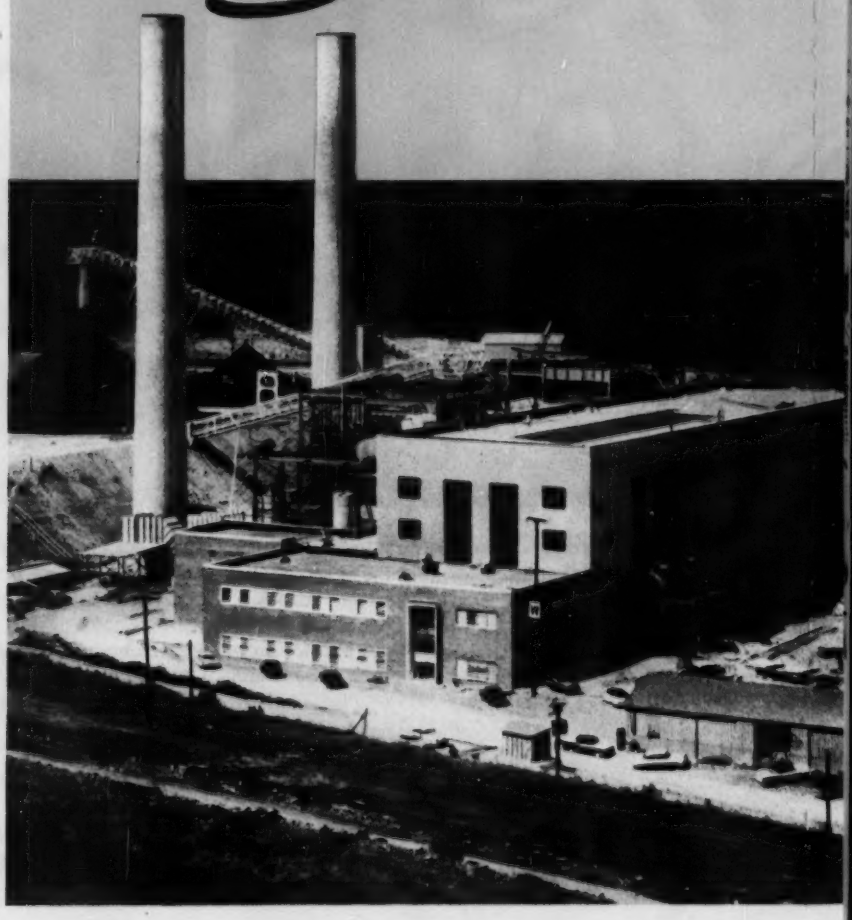
LAKE CATHERINE
HUTCHISON
YATES
DUNKIRK
TITUS
LEE
CONTRA COSTA
HAWTHORN
NINEMILE POINT
EDGE MOOR
PALATKA
JOHNSONVILLE
DANSKAMMER
BECKJORD
HIGHGROVE
PLANT X
BLACK DOG
ALBANY
JOPPA
MERAMEC
PORTSMOUTH
LAKE CREEK
ETIWANDA
AURORA
HENNEPIN
EASTLAKE
OAK CREEK
SUWANNEE RIVER
URQUHART
KINGSTON
SANDOW
MULLERGREN
BARRY
NORTH OMAHA
WILMINGTON
CARBON
SAGUARO
MORRO BAY
VERMILION
JOHN SEVIER
COLLIN
MILLIKEN
GALLATIN
BARRETT
MITCHELL
SAN BERNARDINO
YORKTOWN
GULF COAST
TUCSON
PORT WENTWORTH
W. A. PARISH
ALLEN
MONTROSE

McMEEKIN

South Carolina

NEW McMEEKIN STATION

Goes into Service



Electric & Gas Co.'s

A notable expansion of its system was made early in June by South Carolina Electric & Gas Company when it placed in service the first generating unit at the new Silas C. McMeekin Station. The new unit, with a rated capacity of 125,000 kw, was the first of two duplicates. No. 2 went on the line in November. Gilbert Associates, Inc. are the Consulting Engineers.

Power studies, conducted to determine the requirements of the rapidly growing area served by the South Carolina Electric & Gas System, indicated the need for new capacity in the vicinity of Columbia. It was decided therefore to locate the new McMeekin Plant on Lake Murray, 12 miles west of the city, on the site of the Saluda Hydroelectric Station where an excellent source of feed and condensing water is available.

Both generating units at the McMeekin Station are served by C-E Controlled Circulation Boilers, a cross-sectional elevation and brief description of which appear below.

COMBUSTION ENGINEERING

Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

C-194

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

One of two duplicate C-E units now in service at the McMeekin Station. It is of the controlled circulation, radiant reheat type, with a divided furnace arrangement. The reheater is comprised of both radiant and convection surface at the top of the furnace, with radiant platens intermeshed with the forward platens of the secondary superheater. An economizer section is located below the rear superheater surface. Regenerative-type air heaters follow the economizer surface. Each unit is designed to serve a 125,000 kw turbine generator operating at a throttle pressure of 2400 psig, and with primary steam temperature of 1050F reheated to 1000F. Fuel is pulverized coal using bowl mills and tilting tangential burners.

North and south business sections of Mishawaka, Ind., are lighted by 94 L-M V-type fluorescent units (188 luminaires), mounted on 30-foot aluminum poles which are staggered at 70-foot spacing. Each of the two 4-foot luminaires in the V has two 100-watt lamps, providing approximately 24,000 lumens per pole. Units were supplied by Englewood Electric Supply of South Bend. Installation was by the Mishawaka Electric Department under the direction of Superintendent Austin R. Klien, with the cooperation of L-M's Field Engineer C. W. Puent. Note the even, diffused lighting.

L-M V-Type Fluorescents Turn Night Into Day At Mishawaka

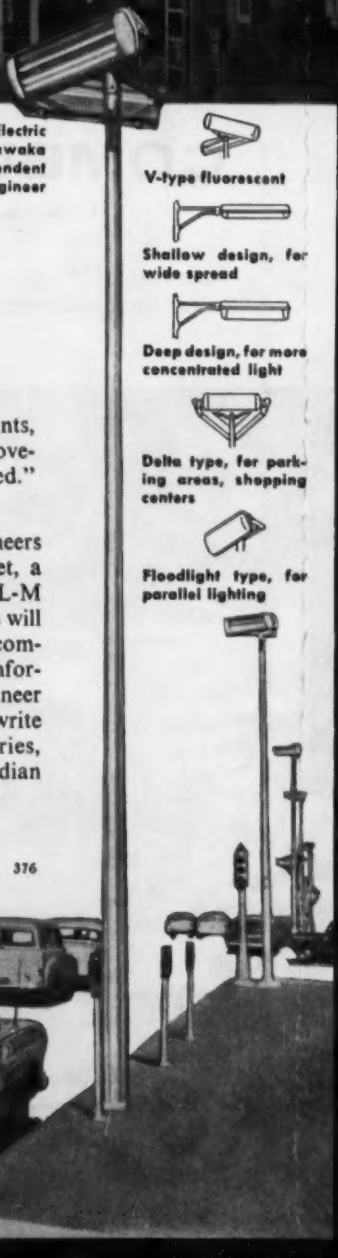
The L-M V-type luminaires used in Mishawaka and many other cities in the country are an outstanding development in outdoor lighting equipment. These V-type units consist of two luminaires mounted at a 45-degree angle to each other. Each luminaire contains two 4-foot 100-watt fluorescent lamps. This gives maximum utilization of the light output.

The design of the luminaires, plus the 30-foot mounting height and 70-foot staggered spacing, results in exceptionally even light distribution.

Referring to the installation, Mayor Albert L. Doyle said: "The installation of our revolutionary fluorescent lighting system is heralded by enthusiastic and universal acclaim by all of our citizens and, most particularly, by our merchants, who honestly feel that a long-awaited improvement has been most satisfactorily completed."

What Do You Want To Light?

Tell us your problem; L-M lighting engineers will help you solve it—whether it's a street, a parking area, a subdivision, or an airport. L-M makes equipment for all, and L-M engineers will design the system you need, and provide complete plans and a bill of materials. For information and bulletins, ask the L-M Field Engineer or Lighting Engineer in your area; or write Lighting Division, Line Material Industries, Milwaukee 1, Wisconsin. In Canada: Canadian Line Materials, Ltd., Toronto 13, Ontario.


V-type fluorescent
Shallow design, for wide spread
Deep design, for more concentrated light
Delta type, for parking areas, shopping centers
Floodlight type, for parallel lighting

376

LINE MATERIAL Industries

McGRAW-EDISON COMPANY

Outdoor Lighting

McGRAW EDISON

DECEMBER 22, 1958

Christmas Is Light!

Our thanks to New Mexico Electric Service Corp for capturing this appropriate thought in a Christmas advertisement a few years ago

Christmas is the bright star that welcomes the Prince of Peace. It is the shining eyes of a child, for at Christmas children take their rightful places as rulers of the land . . . the magically lighted fairyland that is our America.

Christmas is a gayly lighted home where kindly thoughts live with friendly people. It is the look of awe on a child's sweet face when a glittering tree twinkles with colored lights on Christmas morning.

Christmas is a whole city lighted up . . . or a peaceful village with warm bright windows against a wintry night sky. Our forefathers placed a lighted candle in the window to shine a gracious welcome to any who might pass. Today, we use colored lights to perpetuate this beautiful custom.

In cities, towns and villages all over the nation the colored glow of lights lift our eyes from the drabness of winter and rededicate our hearts to the Spirit of Christmas.

Key Issue Looms in Bustling

Hearings on Columbia River Development Corp bill bring opposition from power companies on its broad scope. Public power backs 'principle' except preference change

What with breakneck construction schedules, the spirited effort on the elections and, earlier this month, a cold, damaging blizzard, Pacific Northwest utilities would appear to be due for a respite. Instead, they are in the midst of hassling over one of the nation's most important private-vs-public power issues—the proposed Columbia River Development Corp.

Last fortnight businessmen, irrigation farmers and contractors joined private utilities in forceful opposition to the bill that would create the corporation. In hearings held in the four states the corporation would cover, objectors called it a "thinly disguised CVA" unneeded for continued rapid development of power resources of the Columbia.

Neuberger maintained the purpose of the bill, which would amend the Bonneville Act, is to provide "continuity of financing" of congressionally authorized federal projects by giving the corporation authority to provide building funds for federal agencies.

Sen Neuberger presided over three of the four hearings, sitting as a one-man subcommittee on flood control of the Senate Public Works Committee. Testimony was given at Portland, Seattle, Coeur d'Alene, Idaho, and Kalispell, Mont.

Objections of power companies were concisely expressed by Wendell Black, Puget Sound Power & Light Co general counsel, at Seattle. He outlined these:

1. General purpose of the bill is wrong in superimposing a federal corporation atop already successful local development of resources via partnership.

2. The corporation would endanger existing systems through power to condemn transmission facilities.

3. Being wholly unregulated, the corporation could control its own rates and practices and gain an economic stranglehold on the Northwest.

4. Empowered to intervene in FPC license proceedings, the corporation probably could block projects applied for by utilities by merely stating it had future plans for the site, thereby discouraging local entities of going to the expense of preliminary investigations.

5. Creation of the corporation would virtually nullify existing 20-year contracts of Northwest power companies with BPA.

The proposed bill states ". . . the corporation shall not be bound by the provision of any contract which purports to restrict sales for industrial purposes in any manner not expressly provided for by this Act."

In a statement addressed to the Senate Public Works Committee, Puget Power said that this provision "would mean that the U. S. would be repudiating a contractual commitment."

Kinsey W. Robinson, Washington Water Power Co board chairman and president, pointed out in Coeur d'Alene that existing and scheduled generation in the region will take care of power needs for the next ten years with average water conditions. Existing agencies

NORTH FORK DAM, $20-million 53-Mw Portland General Electric project, went on line last month with first of two generators. Only 35 mi from Portland, the project will make total of 198 Mw capability PGE has added to NW pool

and local utilities can handle the job "in perpetuity," he said.

As did spokesmen for Portland General Electric Co and Pacific Power & Light Co in the Portland hearing, Robinson said the bill's purported aim of self financing actually would be costly to taxpayers. Interest to be paid by the corporation on revenue bonds the U. S. Treasury would be required to buy, he said, would be less than the cost of the money to the government. He termed it "financial chicanery."

Publicly owned utilities favored the "principle" of the bill, although generally objecting to a proposed change of the public preference clause of the Bonneville Act inserted by Neuberger in his latest revision.

Political support for the measure was indicated in Oregon and Washington. Mark Hatfield, Oregon's Republican governor-elect, endorsed the "concept" of the bill, but objected to specific provisions. He wants to see greater local control, including authority of the five-man corporation board—appointed by the President—to hire and fire the corporation's general manager instead of his being an appointee also.

While strongly supporting the bill's principles and objectives, Washington Gov A. D. Rosellini, through his conservation department director, Earl Coe, said the measure should go further "in formulation of policy directives relating to nonpower functions of water resource development." Gov Rosellini is a Democrat.

Montana's Aronson Objects

Only Montana's Republican Gov J. Hugo Aronson opposed the measure. Gov Robert E. Smylie's Republican Idaho administration was not represented at the Coeur d'Alene hearing. Neuberger skipped the strongly critical Coeur d'Alene session to return to Portland for medical treatment.

Neuberger attempted to dispell fears that the corporation would build hydro projects without congressional authorization or condemn existing hydro projects. He said revisions will remove ambiguities.

He admitted he "didn't know" if the bill's power allocation clause would be acceptable to both Washington and Oregon. To meet Oregon fears that the BPA preference clause would give Washington, which has more public power agencies than the three other states combined, a monopoly on federal power, Neuberger pointed to a "fair compromise." The bill would allow the corporation, in the event of shortages, to correct any "unreasonable concentration of power," he said, by taking into consideration the distribution of population, location of projects, and economic needs of the various areas. The allocation right was criticized in Seattle by Coe and Dean Barline, Tacoma director of utilities, as jeopardizing the preference concept.

After the hearings, the senator prepared to draft further amendments in consideration of suggestions and criticisms made in the hearings. The new draft probably will be introduced early in the coming session with additional hearings in the capital to follow. Indicated timetable of the measure is Senate passage in 1959 and House action in 1960.

ROUND BUTTE DAM on Deschutes would produce 300 Mw if $71-million, 440-ft project is authorized for Portland GE

SWIFT HYDRO PROJECT, where placement of earth and rock finished last month, will ultimately produce 250 Mw

DALLES DAM interior shows first six 78-Mw generating units in operation. Seventh will undergo first tests on Jan. 1

Christmas Lighting, 1958

There's a more imaginative sparkle in outdoor lighting displays around the U. S. this year. The creative approach is typified by General Electric Co's Nela Park in Cleveland where settings simulate a frozen pond of lighted bulbs, stained glass windows, and trees gleaming from lights in discarded tin cans. New wrinkles, such as the "topping out" ceremonies on the Time & Life Building's completed steel skeleton, are catching more public interest. And electric utilities across the land are providing incentive, assistance and the juice, of course, for bright manifestations of the Christmas spirit.

GIANT CARD in lights takes up entire front of Chicago's Merchandise Mart. Display has total of 16,000 light bulbs

WIRE DEERS flank Rockefeller Center channel leading to 64-ft high tree. Metal disks in deers interiors reflect antler lights

'TOPPING OUT' of New York Time & Life Building puts 35-ft tree 630 ft high. Display uses 24 kw 'round the clock

STAINED-GLASS WINDOWS have led about half-a-million Nela Park visitors by Nativity Scene, Three Wise Men

U.S. Power Picture

- Cold, snow contribute to new output record for U. S.
- SMUD slates financing for Upper American River work

The electric utility industry will be closing the books for '58 with an impressive looking spurt in its output figures. A lingering cold wave over much of the U. S., coupled with the traditional year-end demand, brought an output of 13,450-million kwhr for the week ending Dec. 13. This is 7% higher than the comparable week in 1957.

With the Weather Bureau's predictions for below seasonal temperatures over the Eastern half of the U. S. for the next 30 days, electric utilities should open the '59 ledgers with a good showing also.

As tabulated by EEI, the seasonally adjusted power output index rose from 242.0 for the week ending Dec. 6 to 246.2 for the subsequent week (1947-49=100).

For the first 50 weeks of 1958, power output is 1.4% above the first 50 weeks of 1957.

Regions Post Gains

All regions continued to show healthy gains in the output comparisons (see p 19). The New England area was up 9.6% over the week ending Dec. 6 and the West Central region posted a rise of 9.4%.

American Electric Power Co reported a system peak of 4,331 Mw on the evening of Dec. 15. This compares with 3,951 Mw for the month of December last year.

Most utilities in the Northeast and portions of the South escaped difficulties from heavy snows that accompanied the cold weather. In Oswego, N. Y., where 88 in. of snow has fallen so far this winter, there has been no general trouble, Niagara Mohawk Power Corp said. The company's bulldozers were pulled from the coal pile to help on the big snow removal job. Snow began falling Dec. 7 and has already exceeded last winter's total.

Eleven inches fell in the Norfolk, Va., area Dec. 12, but had no major effect on Virginia Electric & Power Co's division operations. One 34.5-kv line crossing an inlet was felled when icing occurred. Less than 100 customers were affected by this outage. The unaccustomed snow was accompanied by temperatures that dipped to 15 deg, said J. B. Hawkins, division vice president.

Holidays came early for South Carolina Gas & Electric Co office employees in Columbia on Dec. 12-13. Offices and stores closed after about 8 in. of snow stalled downtown traffic. Temperature dropped to 5 deg., the second lowest reading in some 50 years, and remained in the 20's for four nights. Except for a few service loops dropping, the company had no operating problems, said W. H. Kendrick, vp of electric operations.

Washington State had a rougher time of it from freezing rain, snow and high winds that hit Dec. 6. Puget Sound Power & Light Co had up to 130 men out for most of two days around Bellingham, said John Wallin, district manager. The Lynden area was hard hit also. No major communities were without power for more than a day but some isolated farm families were out for up to three days.

● Sacramento Municipal Utility District will sell $25 million in revenue bonds Jan. 1 to finance in part the construction of the initial stages of the SMUD Upper American River hydro project. SMUD officials estimate the $25 million will finance construction costs through 1959. A second sale of $40 million is planned for early in 1960 and $20 million is expected to be sold early in 1962.

Voters in the utility's service area approved an $85 million revenue bond issue in 1955 for the project.

A survey by Bechtel Corp of San Francisco has indicated the system of dams, tunnels and power plants will cost $100,318,000. SMUD plans to finance the difference between the amount of bonds authorized and the actual construction costs from district revenues.

The Bechtel report supported the feasibility of the SMUD undertaking and noted the first power from the system will flow into the district's lines by the fall of 1960.

OSWEGO—So far, 88 in. of snow

NORFOLK—Low of 15 deg plus 11 in.

COLUMBIA—Snow and chilly 5 deg

LYNDEN—Freezing rains and winds

Fermi Plant Gets Conditional AEC

Intermediate decision affirms the agency's previous licensing action for Fermi plant; unions may intervene

The Atomic Energy Commission has tentatively affirmed its previous decision licensing the Power Reactor Development Co to construct a fast breeder power reactor at Lagoona Beach, Mich. But the company gets no real assurance that commission approval won't be withdrawn later.

Commissioners Vance and Floberg joined in the opinion and initial decision. John Graham concurred in a separate opinion. Dr. W. F. Libby didn't take part because he missed oral arguments due to illness. Chairman John McCone abstained because he wasn't with the commission when the arguments were held.

This unusual action is an intermediate decision just as though an examiner had issued it. Parties have 20 days to file exceptions.

Spokesmen for the AFL-CIO auto, paper and electrical workers unions said they would file objections again. If they do intervene, the plant's construction schedule will not be affected, said Detroit Edison Co Vice President Charles Landrigan. He termed the union spokesmen's threat as only a "nuisance."

Even aside from this tentative nature, the construction permit is provisional. A license authorizing operation of the facility will not be issued unless and until PRDC has submitted to the commission (by proposed amendment to the application) the complete, final hazards summary report—portions of which may be submitted and evaluated from time to time.

AEC Will Reserve Jurisdiction

It is further provisional to the extent that the commission reserves jurisdiction, at any time prior to issuance of an operating license, upon notice to the parties, to reopen the proceeding for the purpose of receiving additional evidence. The AEC would make such determinations and take such action with respect to continuance, modification or cancellation of the construction permit as the entire record warrants.

Once the record is complete, and the commission is finally assured that the plant can and will be operated safely, and after further proceedings, if necessary, the operating license will be issued.

But the decision notes that "the commission regards the importance of public safety so highly that it considers that it does not lose jurisdiction of this subject even after a license has been issued, at any stage in the course of construction, or for that matter, even after a facility is in operation."

Among the findings in the 49-page decision are the following:

". . . There is no inherent hazard or danger to the health and safety of the public in the construction or operation of fast breeder reactors."

". . . The fast breeder reactor is one of the promising types for the

New A-Power Group Faces Early Gauntlet

Decision by Pennsylvania P&L-Westinghouse to drop homogeneous reactor puts gas-cooled reactor plan in jeopardy

The "partnership" proposal by 51 private power companies to build a gas-cooled reactor is in increased jeopardy in the wake of the decision by Pennsylvania Power & Light Co and Westinghouse to withdraw their proposal for construction of a large-scale homogenous reactor.

PP&L and Westinghouse said they were still convinced that the homogeneous reactor concept holds promise—but they added that so much more research and development work is needed that construction is not feasible now.

Sen Clinton Anderson (D-N.M.), who will be chairman of the joint committee next year, immediately seized on the announcement as proof of his contention that private industry can't be relied on to develop advanced reactor concepts.

He recalled that Charles E. Oakes, board chairman of PP&L, has been in the forefront of those opposing federal reactors, and reiterated his belief that the project was conceived as a means of heading off a government program.

"I believe this project demonstrates the fallacy of expecting private industry to provide the technical direction and financing for construction of advanced reactor concepts," says Anderson. "I hope AEC and parts of industry will reexamine their views in the light of this experience.

"As a matter of national policy, I believe it is undesirable to permit the field of advanced atomic power concepts to be staked out as the private domain of industry," he says. The AEC should develop advanced reactor concepts, with private industry coming in to sponsor second and third generation projects with government assistance, he adds.

In effect, he is serving notice that the joint committee will look with a jaundiced eye on the recent Philadelphia Electric Co proposal, along with 50 other operating companies, to build and develop a high-performance gas-cooled reactor for a 150-Mw plant.

Commission sources predict AEC will beat the February deadline for a decision on the proposal by a wide margin. There is little doubt among AEC staffers that the proposal—involving $14-million in government research and development aid—will be accepted by the commission.

Backing

development of electric power on a commercially feasible basis."

". . . In view of the population density around the site, its suitability for the proposed reactor depends upon the inherent safety of the reactor and a demonstration that no credible accident can release significant quantities of fission products into the atmosphere. If the foregoing are established, and there is reasonable assurance that they can be, it is probable that the site will prove suitable for the proposed reactor."

Final Answers Must Wait

". . . The record indicates that none of the questions relating to reactor safety, the feasibility of the reactor design and the adequacy of the financing can be absolutely and finally answered at this time."

AEC notes that PRDC's current estimate for cost of construction, preconstruction R & D, and administrative expenses during construction and test operation is $44,020,000.

Construction of Plant to Continue on Schedule

Construction on Enrico Fermi plant will continue on schedule with a target date for completion in 1960, Detroit Edison Co indicated last week after the AEC's tentative decision.

Power Reactor Development Corp, a non-profit group, will own and operate the atomic reactor, heat exchangers and related facilities. PRDC is made up of 21 power and industrial companies. Research, basic design and testing are being handled by the non-profit Atomic Power Development Associates, Inc, a group of 43 industrial firms. Detroit Edison will own and operate the conventional facilities.

The structures are: **1.** Reactor containment building. **2.** Temporary equipment entry chamber. **3.** Sodium tunnel. **4.** Sodium storage and purification building. **5.** Plant offices and control center. **6.** Boiler house foundation. **7.** Water treatment plant. **8.** Turbine house location. **9.** Water storage tank. **10.** Construction offices. **11.** Detroit Ed's information center which in three months has been visited by 12,000 people. **12.** Meteorological tower operated by the University of Michigan's Engineering Research Institute.

Study Set on Disposal Problems

Joint committee will probe adequacy of R&D on radioactive waste disposal, particularly used-up fuel elements

A major study of industrial radioactive waste disposal will be conducted by the Joint Committee on Atomic Energy. Five days of hearings are scheduled to begin Jan. 28 and conclude Feb. 3.

Rep Chet Holifield (D-Calif.), whose special subcommittee on radiation will conduct the hearings, says they will be as thorough as the '57 inquiry on radioactive fallout.

Among other things, the investigators want to know what waste management procedures are used or contemplated now at Shippingport and at various AEC installations.

"The matter of disposing of radioactive waste materials is a problem that must be solved as the nation heads into an era of growth of the atomic power industry," says Holifield. "The purpose of these hearings is to find out the scope of the problem and possible solutions.

Risks Persist Up to 100 Years

"These wastes, principally used-up nuclear fuel elements, are highly radioactive and remain so for extremely long period—as much as 100 years in some cases," he adds.

"We intend to find out whether the present scale of research and development into the matter of waste disposal is adequate to meet the needs of the coming era. Once the day of large-scale use of nuclear power comes, it will be too late to start finding the answer to the disposal problems."

The role of federal and state agencies in regulating waste disposal, as well as the international aspects, will be included.

JCAE spokesmen have outlined a tentative schedule for other hearings by the joint committee which underscores how the atom is putting on a business suit:

1. In mid-January, a review of the Euratom program.

2. Also in January, a "seminar" at which industry spokesmen will give their views on the JCAE staff's proposed long-range program for civilian atomic power development. However there is considerable doubt the seminar will be held apart from the annual "202" hearings.

3. In mid-February, the annual "202" hearings.

4. In March, the first JCAE inquiry into workmen's compensation.

5. In April, a review of the patent provisions of the 1954 act. The law's compulsory licensing provisions expire Aug. 31, 1959.

6. May, federal-state relations.

The Washington Wire

- **Controversial Mountain Sheep included in Corps plan**
- **Farm Bureau Federation opposes more basin authorities**

Twelve new hydro projects—including a high Mountain Sheep dam on the Snake River—were recommended last fortnight for the Columbia River system in the long-awaited Corps of Engineers report by the North Pacific division engineers. Cost of the overall program would be $1.8 billion.

Top of the list is the recommendation for Mountain Sheep, a project for which the Pacific Northwest Power Co is seeking a license from the FPC.

Initial installed capacity of the 12 multi-purpose projects would be nearly 3.2-million kw. If constructed in accordance with the major water plan proposed in the Army's review, the total added capacity would be 4-million kw, bringing to 10.4-million kw available from hydro projects in the area.

Would Meet 1985 Growth

This increase would take care of a good part of the load growth projected for the Northwest by 1985. The maximum forecast is 22.8-million kw in 1985; the minimum is 16.5-million kw.

Thermal plants would make up the difference. The report claims a saving of some $60 million over thermal costs if the water projects go through.

The new recommendation for a high Mountain Sheep dam amounts to a backing of the project by the Corps itself—a position it is taking despite opposition by other government officials.

Choice of high Mountain Sheep, on the middle Snake below the mouth of the Imnaha, sets up the hottest issue in the division engineer's document. The full report got its baptism of fire in Portland at a joint meeting of the Columbia Basin's federal state inter-agency committee and Inland Empire Waterways Association.

The report, already reviewed by the U. S. Corps of Engineers in Washington, will become part of recommendations to the Corps' board for rivers and harbors, which works on feasibility decisions to place in the congressional hopper.

The Army Engineers decision to recommend Mountain Sheep flouts the advice of Interior Secretary Fred Seaton, who six weeks ago asked the Army not to block access of spawning fish to the Imnaha. Over his objection, the Engineers adopted the high dam plan and site proposed last spring by the Pacific Northwest Power Co (a combination of four utilities) to FPC.

• The American Farm Bureau Federation, at its 40th annual convention in Boston, has re-stated opposition to creation of new federal river basin authorities and the entry of federal government in power production. It again came out in support of TVA as a "desirable method, under the circumstances," for resource and power development in that area.

The federation favored creation of federal-state commissions to study multiple-purpose watershed planning in the various basins. It voted against establishment of additional river basin authorities, though, and specifically denounced Sen Richard Neuberger's proposal for a "valley-type" corporation.

In addition, the federation recommended that state or local bodies should be "permitted and encouraged" to take over the operation and ownership of existing federal authorities, except for TVA.

The group supports TVA self financing, providing controls on service area and bonds are included.

On power policy, AFBF resolved:

1. That private enterprise—either cooperative or non-cooperative—should produce, transmit and distribute power, including that from the atom.

2. Non-federal or private systems should be able to buy, without rate preference, the right to generate power at federal power dams.

3. Federal power prices should include all costs allocated to power, plus an amount of equal to federal taxes, if the property were privately owned.

4. Co-ops and municipals should have "first opportunity" to buy federal power, but an amendment to the Bonneville Power Act should be enacted to permit private utilities to obtain the same preference.

5. Federal power facilities should be sold to local, state or private systems "where desired by the people and governments of the areas."

Rates and Regulation

- **Utah commission calls FPC institutional ad ruling 'unfair'**

If the Federal Power Commission prevents power companies from including advertising costs in their operating expenses, it will "curtail the right of free speech." This is the view of the Utah Public Service Commission whose chairman, Hal S. Bennett, had this to say about FPC's position:

"It is unfair for a regulatory commission to deprive investor-owned utilities of the privilege of bringing facts concerning public power competition to their customers while their competitors are free to carry on advertising and similar programs unrestricted."

Utah Power & Light Co, "is not only entitled to but should meet competition of publicity, promotion and advertising on the part of proponents of government power," Bennett said. Utah P&L is one of the backers of the Electric Companies Advertising Program. The FPC ruled that the expense for ECAP ads dealing with public vs private power are not deductible for income tax purposes.

The Utah commission's action followed close on the heels of the National Association of Railroad and Utilities Commissioners' resolution on a similar ruling by the Internal Revenue Service. NARUC agreed at its annual meeting that the IRS ruling should "be rescinded and annulled."

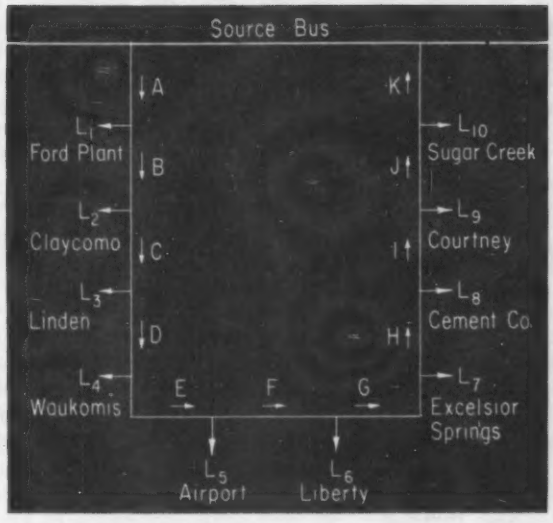


FIG 1—LOOP CIRCUIT involved 11 line sections, ten loads. Currents in same direction as arrows are taken as positive

THE AUTHORS, C. C. Taylor, left, and S. H. Pollock, right, use an Electrodata 101 computer for analyzing loop circuit

Computer Analyzes Loop Circuit

Electrodata 101, using true vector solution, speedily gives watts, vars, load-point voltages, and total circuit losses

S. H. POLLOCK, Principal Engineer,
C. C. TAYLOR, Engineer, Kansas City Power & Light Co, Kansas City, Mo.

Loop-circuit analysis is faster and more accurate on a digital computer than on a network analyzer. The authors used the small Electrodata 101, but such programming can be readily developed for other computers now available.

In programming for the 101 computer, the true vector solution is used and the answer is printed out in watts and vars in each line section, voltage at each load point, and the total losses in the loop. Check points are included in the program and, as the machine prints these out (if they check), correct answers are assured.

The problem involved 11 line sections and ten loads. Currents in the line sections were marked A, B, C . . . K. Arrows show line currents flowing in the same direction; currents flowing opposite to the arrow direction are taken as negative quantities by the computer.

With reference to Fig 1, the current equations were written as shown in Table I, where the total voltage drop around the loop, written as (1), was zero. By substituting various current values in terms of A, the latter equation was reduced to that shown as (2). All terms were vector quantities.

Data for the equations were expressed in per unit quantities, a base being chosen so that the largest load had a pu value of less than one. The data included resistance and reactance values for each line section. Latest AIEE recommendations were followed, and the conjugate of the impedance was used. This means that the line reactances were entered as negative, and lagging var loads as positive values. The R and X for the entire loop were totaled so that these quantities could be used as check points. Admittance for the entire loop was calculated from these.

Load data were in pu watts and vars. For a lagging power factor,

Table I

$$
\begin{aligned}
A &= \qquad\quad = A \\
B &= A - L_1 = A - (L_1 \\
C &= B - L_2 = A - (L_1 + L_2) \\
D &= C - L_3 = A - (L_1 + L_2 + L_3) \\
E &= D - L_4 = A - (L_1 + L_2 + L_3 + L_4) \\
F &= E - L_5 = A - (L_1 + L_2 + L_3 + L_4 + L_5) \\
G &= F - L_6 = A - (L_1 + L_2 + L_3 + L_4 + L_5 + L_6) \\
H &= G - L_7 = A - (L_1 + \text{through } L_7) \\
I &= H - L_8 = A - (L_1 + \text{through } L_8) \\
J &= I - L_9 = A - (L_1 + \text{through } L_9) \\
K &= J - L_{10} = A - (L_1 + \text{through } L_{10})
\end{aligned}
$$

$$(1)\quad AZ_a + BZ_b + CZ_c + DZ_d + EZ_e + FZ_f + GZ_g + HZ_h + IZ_i + JZ_j + KZ_k = 0$$

$$(2)\quad A = \frac{Z_aL_1 + Z_b(L_1 + L_2) + Z_c(L_1 + L_2 + L_3) + \ldots Z_k(L_1 + \text{through } L_{10})}{(Z_a + Z_b + \text{through } Z_k)}$$

watts and vars were entered as positive in the computer. (If generating stations had been at one or more places on the loop, they would have been handled by entering their inputs of watts and vars to the loop as negative values). The watts and vars of the loads were totaled and recorded and thereafter used as check points.

The data were stored internally on a magnetic drum; all instructions were located internally in "pinboards." In the solution, the first step was to enter data in the computer "memory," which involved the use of three pinboards marked "enter data."

Zeros Fill Vacancies

These boards were inserted in the computer. All resistance values were entered, one after the other, starting with line A, Fig 1. For this a keyboard was used. As the computer is set up for 20 line sections, 20 resistance values must be used. When a problem has less than 20, zeros fill the vacancies out to 20, in which case, the computer prints out the total, which should check with total resistance of the loop.

Resistance values were entered as negative quantities, and the machine again printed the total reactance value as a check point. At this time loads were entered. There is always one less load than there are line sections, so that the first load entered was L_0, whose value was zero. Watt loads were entered for each load, zeros again being used to fill out for 20 loads. The computer printed the total of watt loads, and the total was checked against original data.

Next, all 20 reactive loads were entered, starting with a zero and filling out, where necessary, with zeros. Lagging var loads were entered as positive and leading var loads as negative values. The computer printed total vars entered as a check point.

Next, real and imaginary parts of the total line admittance were entered. Both values were positive, as conjugates were used in the solution. Then half the voltage was entered twice. It was entered thus for convenience. Six more zeros were added to clear certain locations on the magnetic drum for future operations.

At this point all data had been entered in the computer which automatically stopped and was ready to proceed with calculations. Eight pinboards gave instructions on how to calculate. The three "enter data" pinboards were removed, and the eight for calculations were inserted. When the "start" button was pressed, the computer did the rest.

20 Values Printed

First it printed out the pu watts and vars in each line section. Positive values indicated that the direction of flow followed the arrows in Fig 1. Negative values indicated opposite flow. The computer printed out 20 values, repeating the last one when the total was less than 20.

Next, the computer printed out voltages, real and imaginary, at each load point, starting at A. The final value printed was the bus voltage and, as a check, this should very nearly equal the starting voltage. The final value printed by the computer was the pu watts loss in the entire circuit.

The computer printed the complete solution of the loop, including current in each section, voltage at each load point, and the total losses in about 8 min. Further study of the circuit would only require reinserting the three "enter-data" pinboards, entering different impedance and/or load values, and starting the machine to calculate for the new conditions.

Gives 11 Decimal Places

The digital computer's speed and accuracy give it advantages over the network analyzer. Pinboards are set up much faster than the analyzer, although data preparation takes about the same time on each machine. But the computer prints all answers to 11 decimal places. Thus there are no reading errors and, with the check points in the program, correct answers are assured.

The accuracy of the loss calculations for any given conditions is a distinct advantage, as the analyzer does not give losses. Calculations from the data are laborious and often inconsistent.

As a sample problem, consider a 69-kv loop circuit. On a 100 Mva base, the pu impedance values and loads are those in Table II, line voltage being assumed as 1.03 pu volts. After insertion of the Table II values, the computer prints out the answers. The identifying letters and column headings have been added for reference.

Watts and vars are given for each line section; the voltage at the load points, starting with load L_1. It will be noted that the last voltage is very near the starting voltage of $1.03 + j0$.

The final lone numeral is watts loss in the entire circuit. The decimal point in all numbers is to the right of the first digit. All values are in pu terms on a 100-Mva base. While, for this solution, the computer was set up to handle only 20 line sections, it could be shifted to 40-line sections by changing the instruction.

Table II

	Line Impedance			Loads	
	Resistance	Reactance		Watts	Vars
A	0.02616	−0.08153	L_0	0.00000	0.00000
B	0.02221	−0.06628	L_1	0.10211	0.04946
C	0.01728	−0.05156	L_2	0.06194	0.03000
D	0.03794	−0.09716	L_3	0.04604	0.02230
E	0.02919	−0.06681	L_4	0.01088	0.00527
F	0.12686	−0.28712	L_5	0.03622	0.01191
G	0.01544	−0.03277	L_6	0.12648	0.07838
H	0.06358	−0.11725	L_7	0.10337	0.03398
I	0.02310	−0.04261	L_8	0.08217	0.02701
J	0.05255	−0.09023	L_9	0.02009	0.00973
K	0.01846	−0.03689	L_{10}	0.02260	0.01095
Total	0.43277	−0.97021	Total	0.61190	0.27899
Admittance	0.38349	+0.85967			

Brings Automatic Station Closer

Automatic data handling is next step after existing centralized control room toward ultimate in station operation

HAMMOND LADD, JR, Kybernetes Division, Hagan Chemicals & Controls, Inc., Pittsburgh, Pa.

Complete automation of data handling combined with the centralized control room, which is already in wide use, would achieve that ultimate, the wholly automatic station. Although the centralized control room solved many problems in station operation, later developments fostered new ones. The centralized control room is seen now to have one important drawback: It lacks the desired speed in the accurate interpretation of voluminous, complex data.

Precludes Errors

At most stations an operator scans numerous instruments while recording their readings in a log. When he had scanned the last instrument, his last readings, because of fast-changing conditions on today's electrical systems, often bears little time relationship to his first one. But a data-logging system not only collects the readings in seconds but also precludes errors in reading arising from pen-width and parallax.

Today's data-handling equipment logs and scans flows, pressures, temperatures, levels, kwhr, 0_2 analyzers, pH conductivity cells, ratios, etc. In fact, it logs and scans all factors currently recorded and indicated by other means, and computes net Btu's, heat rates, flow integrations, and flow compensations.

There Are Limitations

Such equipment can log, monitor, and compute a great number of process readings, its practical limitations being those of time and space. Time represents the seconds for putting information on the output devices which record it; space, the actual area for expanding the data system horizontally to perform even more sampling. Computations may be limited by the variety and complexity of formulas used.

Employed only to log readings and replace manpower, automatic data-handling equipment would be difficult to justify economically. But it would be warranted were the equipment to furnish an operator with faster, more accurate operational conclusions. And besides reducing the chances of error and enhancing efficiency, it must clear the way to the wholly automatic station.

Automatic control to the extent that it is now employed accumulates readings from recording equipment. Through the use of a data logger, such data is printed. When processed through a computer-controller for automatic, instantaneous computation, it could also initiate corrective control action.

Incorporation of a computer-controller into the control of a station is practicable when the process to which it is applied is predictable. But it would be difficult to apply it to a boiler which goes on and off the line daily. Yet even with this limitation, today's data-handling equipment could be used in building toward the wholly automatic station, and experience with it is a prerequisite to its adaptation for tomorrow's more sophisticated operations. Therefore, it should be used for such of today's useful operations as are within its design limits, the purchaser, however, keeping in mind that a data logger-scanner, together with its associated computer, needs only additional input equipment to multiply its functions.

Automatic data loggers available today are electronic systems for converting process variables to digital values. Data processed are finally printed on typewriters, off-normal printers, tape punches and/or card punches. Normally the process phases are these:

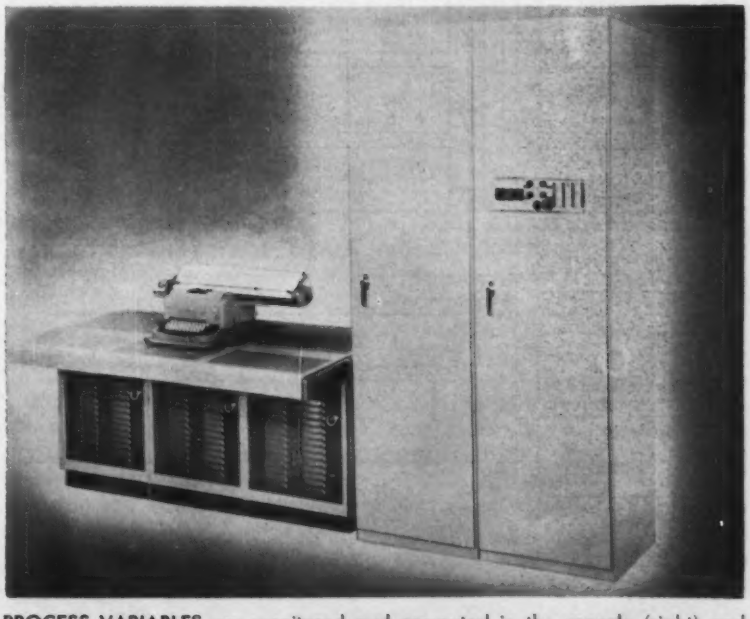
1. Sensing and transmitting devices convert the variable to electrical analog values.

2. The analog values are sequentially transmitted to the data system.

3. In that system, internal programming and sequencing circuits automatically program the signal.

4. The signal passes through amplifying, analog, to digital con-

(*Continued on page* 129)



PROCESS VARIABLES are monitored and computed in the console (right) and sent to typewriter on which they are printed in desired sequence for operations

Automatic Data Logging Expected

Automatic system will make better use of fuel and manpower at NYSE&G's Milliken steam generating station

S. A. LYON, System Results Engr, Mech Engr Department, New York State Electric & Gas Corp, Binghamton, New York

A central information system designed to reduce energy production costs through more efficient utilization of fuel and operating manpower will be placed in service simultaneously with or shortly following the second 150-Mw unit at Milliken Station.

This new tool will be used with the existing as well as the new unit. The justification for using the system is based on the utility's confidence that it will make feasible operation of the expanded 300-Mw plant with the same number of operating shift employees now needed for operation of the one unit 150-Mw plant.

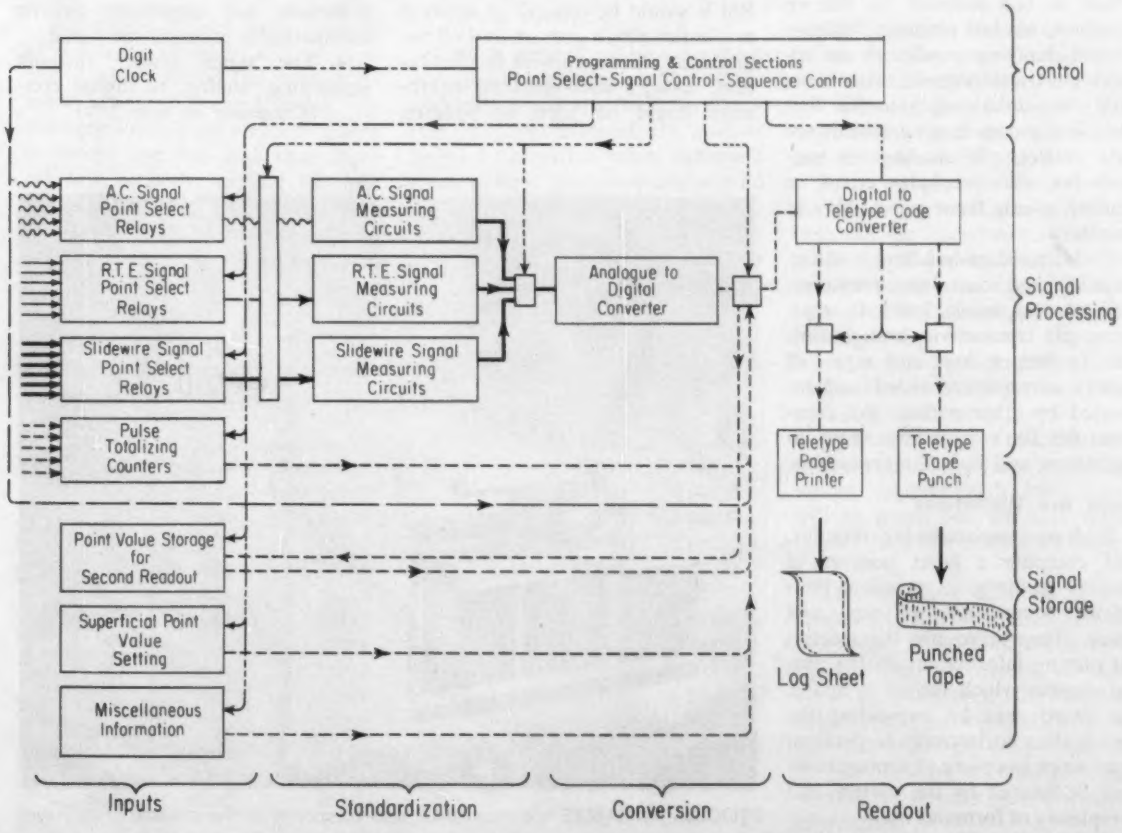
The shift operation for the two 150-Mw units is expected to include: One shift foreman, two control operators, two auxiliary operators, and one utility man (8 AM to 4 PM shift only).

The central information system is expected largely to eliminate the keeping of manual log sheets as well as the routine manual checking of bearing temperatures of auxiliaries. It will do this and also provide a more accurate and unified log of operating intelligence. Thus fewer men will be required for operation. These few men should be able to spend more time in interpreting the significance of the information and in taking appropriate action based thereon.

Better protection and reduced maintenance of auxiliaries is expected to result from the automatic scanning and logging of pressures, bearing temperatures, etc. These were previously checked with a frequency of less than 10% of that of the automatic system and not "trend-logged" at all.

The equipment will also provide basic data that will assist in keeping the station heat rate at a minimum. This is important because the annual value of one Btu per kwhr in net heat rate for the two unit station is expected to average $650 in

Functional Block Diagram for Data Logging System



FUNCTIONAL BLOCK DIAGRAM shows that the outputs of the system can be presented on log sheets or punched tapes

to Cut Costs

the foreseeable future.

The planned installation is designed to permit automatic conversion of operating data to punch card storage for use in computer-assisted analysis of past performance rather than an instantaneous readout of operating efficiency. This is probably the best arrangement for coal fired stations in the present state of the art. Conventional automatic controls supplemented by operator judgment appear capable of maintaining operating efficiency within the limits of instantaneous instrument accuracy.

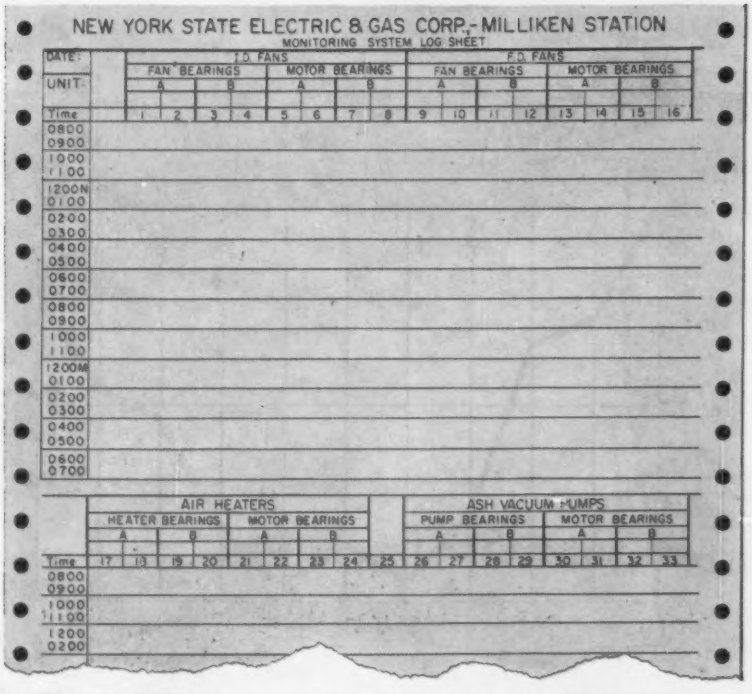
The system is actually made up of two essentially independent components performing, respectively, the functions of monitoring and performance data recording.

The monitoring component will scan 265 temperatures and pressures (not otherwise centrally reported) every five min, compare each with an "alarm" or "set" point, alarm any inputs found to be in alarm range, and type identification and digital value for each such "off normal" response. Once per hr it will type a log of 267 instantaneous values, plus time and "calibration check". "Off normals" will be indicated by underscoring. In addition, the unit will log any point on operator demand.

The performance data recording component is designed to log and/or tape 59 instantaneous and 26 integrated values, including several programmed repetitions, once per hour.

In constructing both the data recording and monitoring systems considerable effort has been made to reduce the "down time" and to generally increase the unit's reliability. As an additional feature contributing to "selective" reliability, all four teletype printers normally used in the combined system are interchangeable and may be "plugged in" to maintain the most essential outputs in the event of failure of one or more of the printers.

All the taped data will be automatically punched into 2,900 eighty-column cards per month. Two card formats are used per boiler-turbogenerator unit, with two cards per hr being produced for each such unit.


NEW YORK STATE ELECTRIC & GAS CORP.-MILLIKEN STATION
MONITORING SYSTEM LOG SHEET

DATE:

	I.D. FANS								F.D. FANS							
UNIT	FAN BEARINGS				MOTOR BEARINGS				FAN BEARINGS				MOTOR BEARINGS			
	A		B		A		B		A		B		A		B	
Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0800 0900																
1000 1100																
1200N 0100																
0200 0300																
0400 0500																
0600 0700																
0800 0900																
1000 1100																
1200M 0100																
0200 0300																
0400 0500																
0600 0700																

	AIR HEATERS									ASH VACUUM PUMPS							
	HEATER BEARINGS				MOTOR BEARINGS					PUMP BEARINGS				MOTOR BEARINGS			
	A		B		A		B			A		B		A		B	
Time	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
0800 0900																	
1000 1100																	
1200 0200																	

SAMPLE LOG SHEET shows the many quantities that can be logged automatically

This procedure was considered the best first step in attaining the goal of complete automatic logging of digitized performance data. The data which has been converted to the punch card form will be processed on electric accounting machine equipment.

This processing is planned to accomplish data reduction and to produce a variety of intermediate performance calculation results such as:

1. Tabulations and summations of data sorted according to electrical output, hour, day, etc.

2. Products and sums of products.

3. Automatic utilization of "constants" from "master" decks of cards.

Emphasize Common Calculations

For the present (and in the absence of a true high speed electronic computer) no attempt will be made to program all calculations on the company's existing accounting equipment. Emphasis is on automating those arithmetical operations which constitute probably 90% to 95% of those involved in arriving at such end results as:

1. More reliable and easily prepared routine station performance reports.

2. More reliable and less expensive monthly diagnostic reports on turbine and boiler cycles.

3. Evaluation of the effect of "non valve point" operation on monthly turbine heat rate.

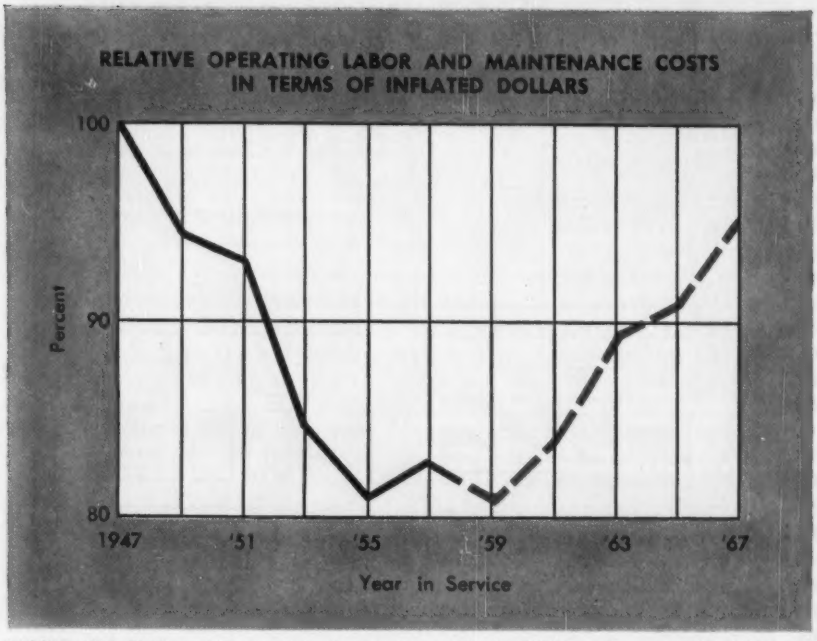
4. Performance checks of the following under a variety of specific operating conditions.

a. Condenser
b. Flowmeters (cross checks)
c. Turbine (heat rate)
d. Boiler (efficiency)

While detailed information about these applications is, in most instances, available in company files, the material is too detailed and voluminous for complete presentation in this article. Moreover, the extent to which these applications will be found to be routinely feasible is a function of the as yet unproven reliability and accuracy of the planned installation.

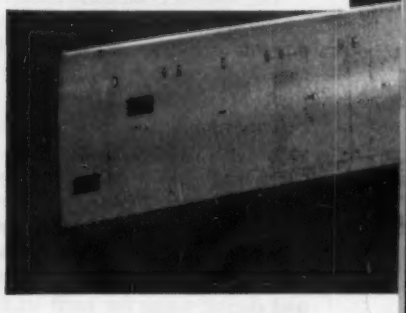
In an effort to secure acceptably accurate data, high quality commercially available sensing devices have been utilized to provide inputs to the performance data logger. De-

(*Continued on page* 129)

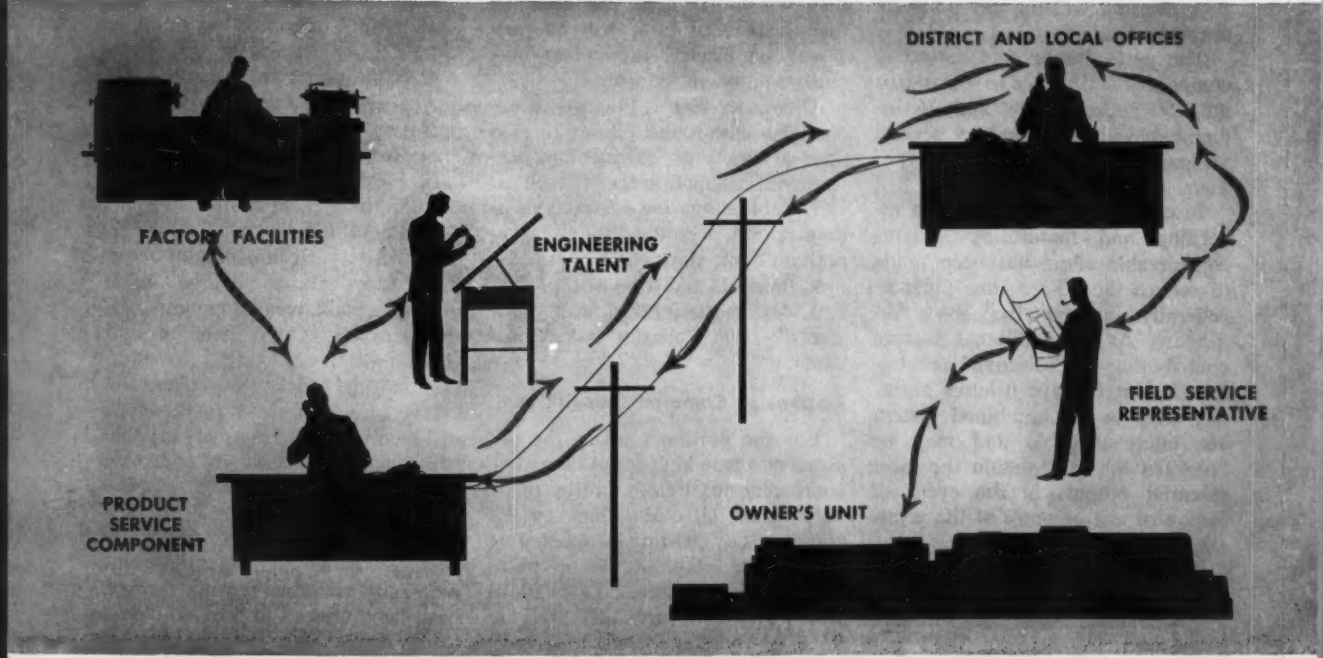


LARGER UNIT SIZES and improved heat rates have helped utilities reduce operating labor and maintenance costs. However, if these costs are projected at the 1947–57 inflationary rate, this trend will be reversed as indicated above. Accordingly, General Electric is constantly strengthening all phases of its present intensive efforts that help in *KEEPING POWER MAKERS ON THE LINE*, thereby promoting even more economical generation of electricity.

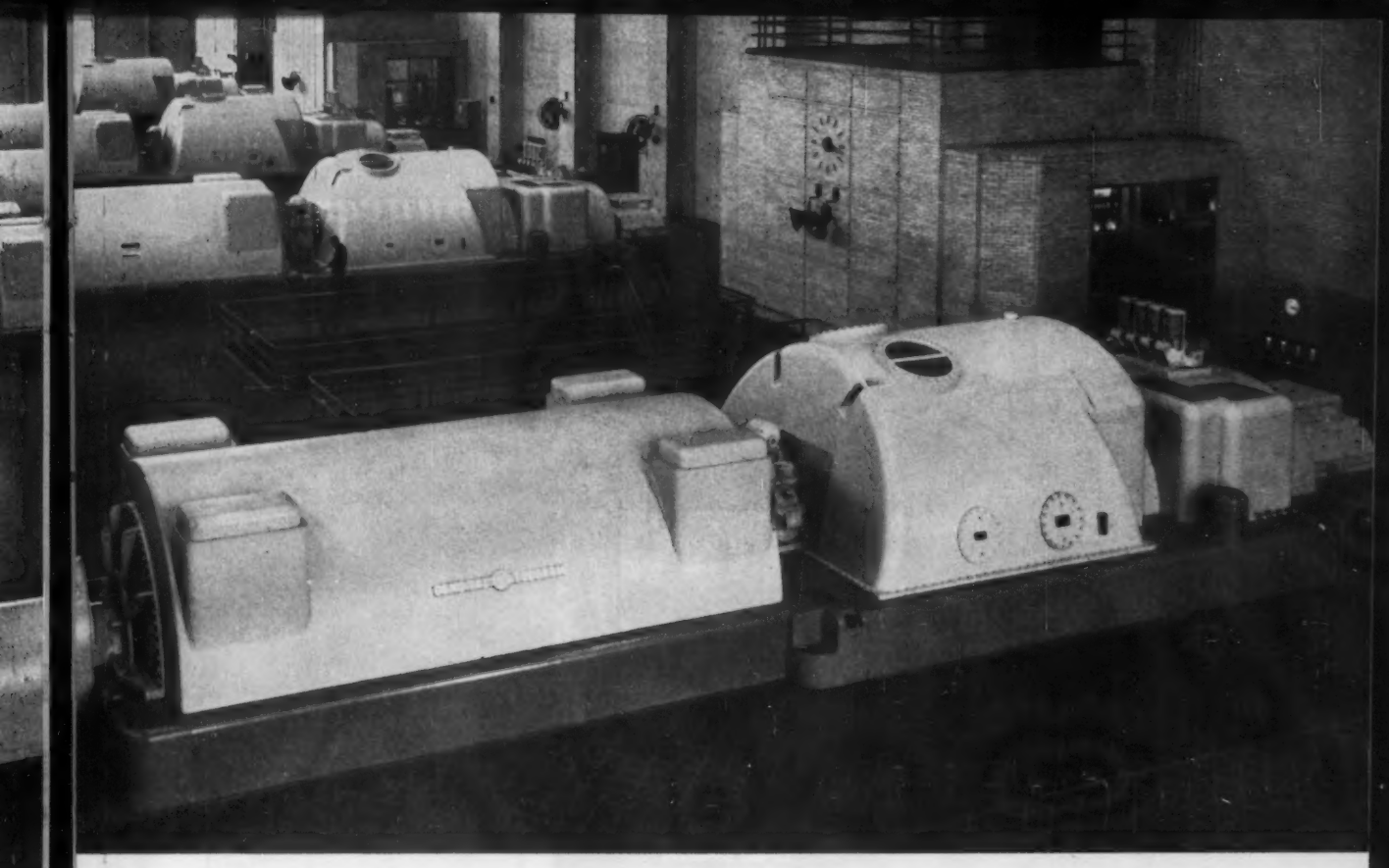
KEEPING POWER MAKERS ON THE LINE, operating at top efficiency is the job of over 400 G-E turbine-generator field representatives backed by well-rounded district organizations, and by complete manufacturing facilities and engineering talent at the factory. Pictured here are four General Electric units installed at the Albany Steam Station, Niagara Mohawk Power Corporation.



Completely integrated service helps keep



TWO-WAY FLOW OF SERVICE INFORMATION through the Product Service component enables factory "know-how" to supplement the efforts of your field service representatives, and permits design and manufacturing specialists to take full advantage of field operating experiences.



General Electric power makers on the line

From the time an order is placed, through design, manufacturing, installation, and during the life of every unit, a well-trained service team is constantly available. Turbine-generator field representatives and local specialists are backed by a Product Service organization at the factory. This component channels all incoming and outgoing information and coordinates the application of factory talents and facilities to individual owner's problems.

Here are some ways General Electric service helps maintain the product superiority built into each unit:

***Installation Service Study Team**—helps simplify field erection by continually studying methods for reducing installation time and cost. It also seeks easier inspection procedures by suggesting appropriate improvements in equipment design.*

***Performance Interpretation**—helps owners evaluate abnormal sectional pressures and efficiencies, loss of capacity, and other operating irregularities. General Electric initiates tests to prove new designs, and aids owners in conducting their own performance tests on duplicate machines.*

***Engineering Consultation**—is continuously available from factory components. Here electrical and mechanical engineers specialize in providing prompt supporting attention to problems that may arise during the life of your unit.*

***Materials and Processes Laboratory Assistance**—is offered for any unusual service requirement. Nearly 300 physicists, chemists, specialists and technicians are available for field studies, consultation, and advanced non-destructive testing.*

***Maintenance Task Force**—establishes procedures to speed repairs and minimize outages by: assuring efficient repair routines, carefully analyzing shop operations to eliminate uncertainties, and coordinating our action with owner's requirements.*

***Material Procurement Advantages**—help reduce maintenance downtime. Large volume production, a backlog of currently approved materials such as composite forgings, tubing, and bar stock, and an efficient purchasing organization constitute powerful aids in meeting emergency requirements.*

Complete service—designed to provide maximum assistance and satisfaction to the owner—is part of the "added value" you purchase with every General Electric steam turbine-generator. For more information, write for publication GED-3666, Large Steam Turbine-Generator Department, Schenectady 5, New York. 254-76

Progress Is Our Most Important Product

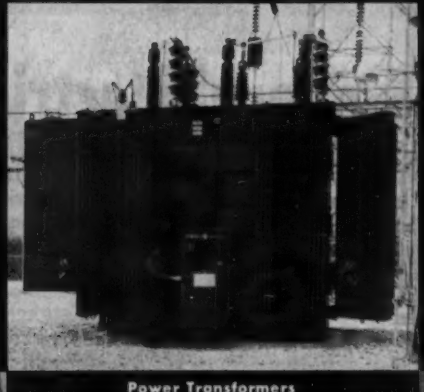
GENERAL ELECTRIC

Progress that Pays Off

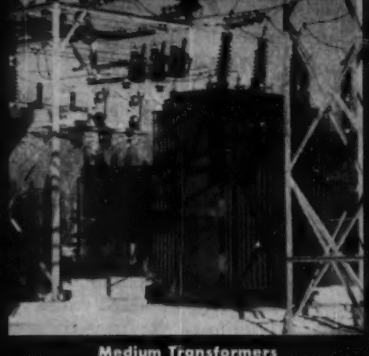
General Electric Announces . . .

INTERCHANGEABLE

Circuit Breakers

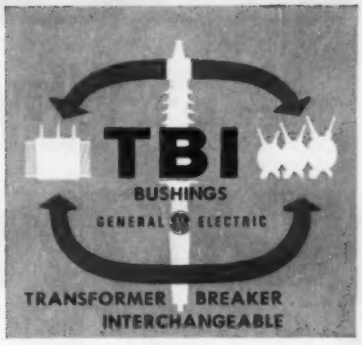


Power Transformers



Medium Transformers

BUSHINGS



8 basic designs 23 kv to 196 kv directly interchangeable between transformers and circuit breakers

How progress in bushings pays off . . .

- You can cut your inventories as much as 75%—these eight basic bushings replace the 37 bushings permitted in latest ASA standards. G.E. estimates $5 million saving to utilities.
- You simplify your stocking and ordering—same bushings fit breakers *and* transformers.
- You help fight price inflation—by manufacturing more of fewer types the savings of volume production help offset mounting costs.

TBI‡ (transformer breaker interchangeable) bushings all incorporate the proved features of G-E Type U design which permits reductions up to 25% in size and weight. An exclusive Rescon* paper core means optimum voltage gradient. Insulating structure is completely oil impregnated and void-free for greater reliability. All bushings are easy to inspect because of convenient liquid level indication even in the smaller ratings.

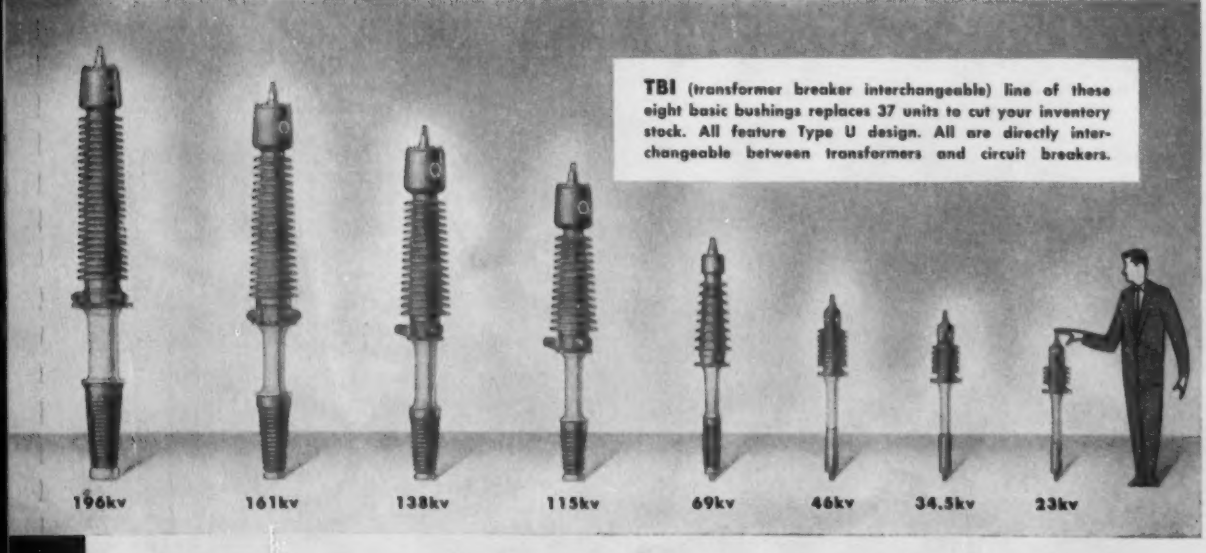
TBI bushings will be available for use on power and medium transformers and circuit breakers after February 1, 1959. For further information contact your local General Electric Sales Office. Section 421-57, General Electric Company, Schenectady 5, N. Y.

‡ Trademark of General Electric Company.

* Rescon—trademark of General Electric Company for a form of semiconductor material.

Progress Is Our Most Important Product

GENERAL ELECTRIC


TBI (transformer breaker interchangeable) line of these eight basic bushings replaces 37 units to cut your inventory stock. All feature Type U design. All are directly interchangeable between transformers and circuit breakers.
196kv
161kv
138kv
115kv
69kv
46kv
34.5kv
23kv

Why does General Electric

A FUNDAMENTAL DISCUSSION OF 32-STEP REGULATORS

by M. W. GANGEL, Distribution Systems, Electric Utility Application Engineering, General Electric Company.

advocate 32-step regulators?

ANSWER: Because 32-step regulators offer three fundamental benefits which add up to extra profit:

1. **EXTRA FEEDER LENGTH**
2. **EXTRA FEEDER CAPACITY**
3. **EXTRA FEEDER REVENUE**

QUESTION: What characteristics of a 32-step regulator make possible these added benefits?

ANSWER: Basically, the step size. It is fundamental that with the smaller step size, the bandwidth can be narrower, regardless of any other considerations. The theoretical minimum bandwidth which can be set is equal to the step size. Under actual conditions, the minimum bandwidth is approximately 115 percent of the step size, plus an adder of from ½ volt to one volt, depending upon the type of control involved. This results in a minimum practical bandwidth setting of approximately 1½ volts for a 32-step regulator and approximately three volts for a 16-step regulator. The *difference of 1½ volts is a dividend in favor of 32-step regulators.*

QUESTION: Why do discussions of regulators lead to the topic of bandwidth?

ANSWER: Bandwidth is an economical source of extra volts . . . volts available for profitable re-investment. Volts used in bandwidth are not available for work out on the feeder. For every volt taken out of the bandwidth, the average voltage to each consumer is improved by ½ volt, and the minimum voltage to each consumer is likewise improved by one volt.

QUESTION: Where can volts from the bandwidth of 32-step regulators be re-invested for greater distribution system economy?

ANSWER: The 1½-volt dividend available only from 32-step regulators will allow additional growth on a feeder without exceeding acceptable voltage limitations. For example, with a permissible four-volt primary circuit drop, the 1½ volts taken from the bandwidth and put to work on the primary circuit permits a *load increase of 37½ percent.* If, on the same primary feeder, the feeder length is increased in an area of uniform load density, the 1½ volts taken from the bandwidth of 32-step regulators can be utilized to provide a *17-percent increase in feeder length* without exceeding the voltage limitations of the feeder.

QUESTION: Can these 32-step regulator advantages affect revenue?

ANSWER: Yes. Revenue is a function of the voltage level at the consumer location. The 1½ volts saved from the bandwidth of 32-step regulators increases the consumers' average voltage level by 0.75 volts. This important contribution to revenue can be calculated very simply by inserting local electric utility values into the following equation:

43.8* × Load Factor × Annual Peak KW × rate in dollars per KW-HR = R

R = Annual revenue which can be gained by utilizing the bandwidth dividend available only from 32-step regulators.

* The factor of 43.8 is the product of: 1) 8760 hours per year; 2) 0.5, which represents the assumed ratio of the amount of voltage-sensitive kw-hr load to the total kw-hr load; and 3) 0.01, the increase in each kw-hr of voltage-sensitive load corresponding to a 0.75-volt average voltage level increase at the consumer location.

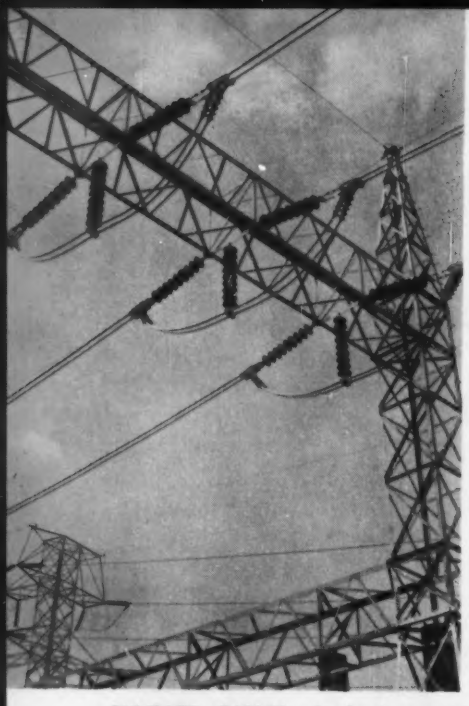
QUESTION: This means that it is quite easy to calculate direct savings from the benefits which the 32-step regulators provide?

ANSWER: Definitely. Simply by setting this reduced bandwidth utilities can begin accruing measurable benefits in terms of reduced system investment and increased revenue. This contribution to profit is one important reason why more General Electric ML-32 step regulators are in service today than any other kind. 423-60

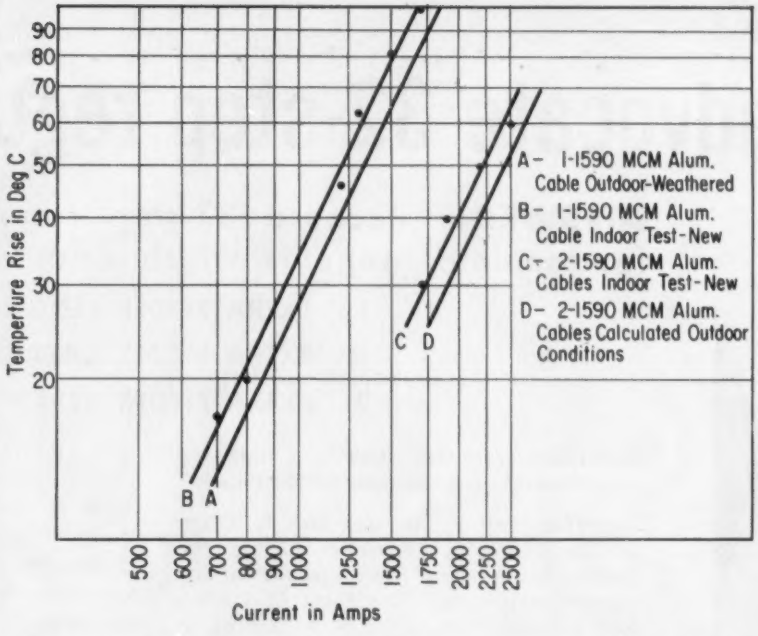
YOUR GENERAL ELECTRIC SALES ENGINEER can give you further details which show why G-E 32-step regulators cost less on the line. General Electric Company, Schenectady, New York.

Progress Is Our Most Important Product

GENERAL ELECTRIC



BUNDLED CABLES of aluminum are deadended with aluminum clamps



SPECIAL TESTS were made to determine the current capacity of bundled cables for out-of-doors and weathered conditions. Curve D is used to load the bus

Bundled Cables Save on 110-Kv Bus

S. R. HART, JR., Engineer I, Substation Design, Alabama Power Co, Birmingham, Ala.

Bundled conductor bus, comprising two 1,590-MCM all-aluminum cables per phase, has been installed at a 110-kv generating plant substation by Alabama Power Co. Use of the bundle configuration reduced weight of the bus, thus saving on structural supports.

The bundled conductor bus was selected for an addition to the existing Gorgas No. 1 Substation. The addition had to be placed between the existing substation and generating units, so the new bus had to be designed to carry present and ultimate generation to existing and future line terminations.

In the existing part of the substation, a double-bus selector-switch scheme was originally installed. Because the company desired to maintain this scheme, which requires high buses, strain buses proved more economical than rigid buses for the addition.

The two aluminum cables carry an estimated 2,000 amp from the generators and tie to the existing 1,000-MCM copper cable bus. In addition to lowering material cost, the bundled cables weigh less per bay than even the existing 1,000-MCM copper bus. The lower weight permitted the use of existing structure designs, rather than heavier new designs.

Cables are bundled horizontally on 5-in. centers. This spacing was selected primarily to allow the use of standard strain clamps and hardware connecting through a yoke to single insulator strings. These connections were facilitated by the adoption of Class A stranded cable, which has 91 strands, instead of AA stranding.

Each cable is continuous for the full length of the five-bay addition, which is 410 ft long. At each support the bundled cables are deadened to avoid problems from short-circuit forces. Due to the short spans, mid-span spacers are not required. Any unbalanced currents are equalized at suspension strings through the use of special double-bus suspension clamps cast from high-conductivity aluminum alloy.

Because no information has been published on the current carrying capacity of such large bundled cables, Alabama Power and a connector manufacturer conducted a series of tests.

Curve A is the published rating of one 1-590-MCM weathered aluminum cable under outdoor conditions. Curves B and C are the test data for a single new cable and the bundled configuration, respectively, under indoor conditions in still, confined air.

These data were translated into outdoor, weathered cable values by applying the increased capacity rating and allowing for increased capacity due to a change in surface emissitivity from about 0.1 for new conductor to 0.5 for weathered cable. The resulting Curve D is being used to load the bus, providing a capacity of 1,900 amp at 30C rise, 2,175 amp at 40C rise, and 2,420 amp at 50C rise, all based on 40C ambient.

During the installation of the bundled cable buses, which were made without difficulty, connectors at suspension strings and line taps were checked carefully to assure equal contact and reduce unbalanced currents.

Positive Protection Against Phase Failure and Phase Reversal ?

Here is your answer!

The Allen-Bradley Bulletin 812 Type F, Type R, and Type RF relays provide positive protection against the hazards to men, motors, and driven machinery, resulting from phase failure and/or phase reversals.

The Bulletin 812 Style F phase failure relay employs a unique static sensing network that responds to all open phase conditions on a motor branch circuit and immediately removes the motor from the line . . . irrespective of the load on the motor (including no load), or the circuit arrangement. This relay even responds to hard-to-detect primary failures on a wye-delta transformer with ungrounded neutral. Furthermore, the five-cycle response prevents nuisance "drop-outs" from transient fluctuations.

The Bulletin 812 Style R phase reversal relay disconnects the motor from the line—whether it is running or not—when a phase reversal occurs anywhere in the system on the line side of the relay. Thus, it can be employed for a single motor, a group of motors, or an entire power system. In addition, the phase reversal relay prevents the motor from starting should phase failure occur while at a standstill—a vital feature for elevator applications.

The Bulletin 812 Style RF relay combines the elements of Style R and Style F relays for protection against both phase failure and phase reversal. All Bulletin 812 relays are inherently "fail safe." Send for complete information.

Allen-Bradley Co., 1316 S. Second St.
Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd.
Galt, Ont.

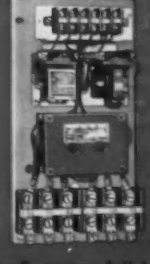
ALLEN-BRADLEY
QUALITY
MOTOR CONTROL

12-58-MR

Bulletin 812, Style RF for Phase Failure and Phase Reversal

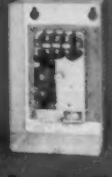
INDIVIDUAL RELAY UNITS AVAILABLE

For Phase Failure

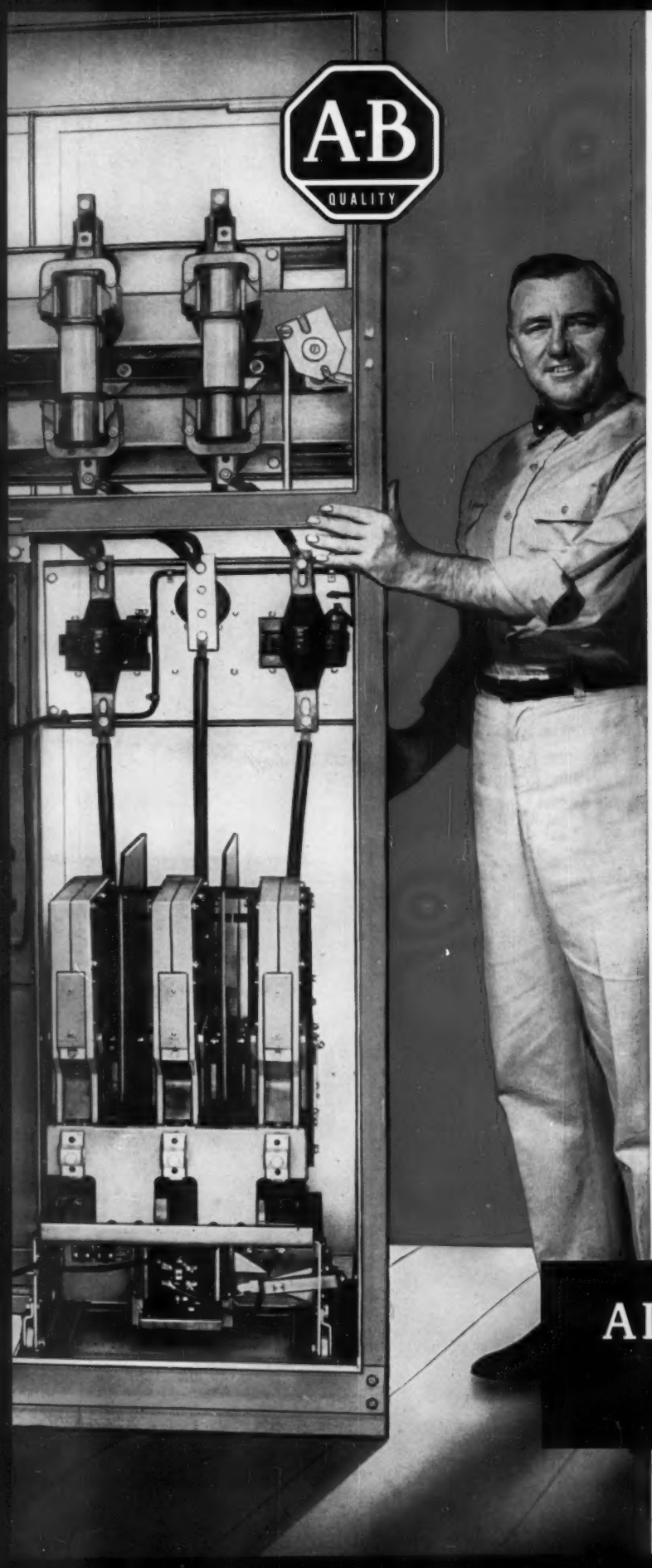


Style F covers full load currents from 1.5 to 300 amp in 4 sizes. Coils for up to 600 v, 60 cycles.

For Phase Reversal



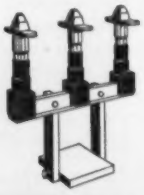
Style R made with coils for 110, 208/220, 440, 550 v for either 50 or 60 cycle operation.



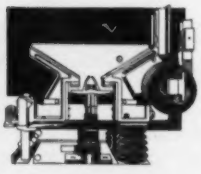
Tough high-voltage job?...Here's the answer!

Allen-Bradley High-Voltage Air Break Starters are ideal for frequent switching, reversing, plugging, or jogging.

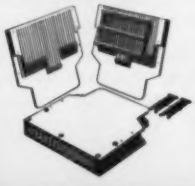
A tremendous operating life has been built into these high-voltage air break starters . . . resulting from the use of the simple solenoid contactor. It's the same design—having only ONE moving part—that provides millions of trouble free operations in Allen-Bradley's low-voltage controls. These starters are made in a complete line for all types of service. Send for Publication 6080, today.



ONLY ONE MOVING PART
With this simple solenoid design, all trouble causing pivots, pins, and flexible jumpers are eliminated. Straight up-and-down motion of contactor is virtually frictionless.



DOUBLE BREAK CONTACTS
Allen-Bradley silver alloy contacts never need maintenance . . . they remain in perfect operating condition until completely worn away. Vertical motion assures uniform contact pressures at all times.



FASTER ARC SUPPRESSION
The air break contactor employs a completely different blowout design and novel arc chute which assure rapid arc extinction. Chutes are molded from arc resistant material.

ALLEN-BRADLEY
MOTOR CONTROL
QUALITY

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

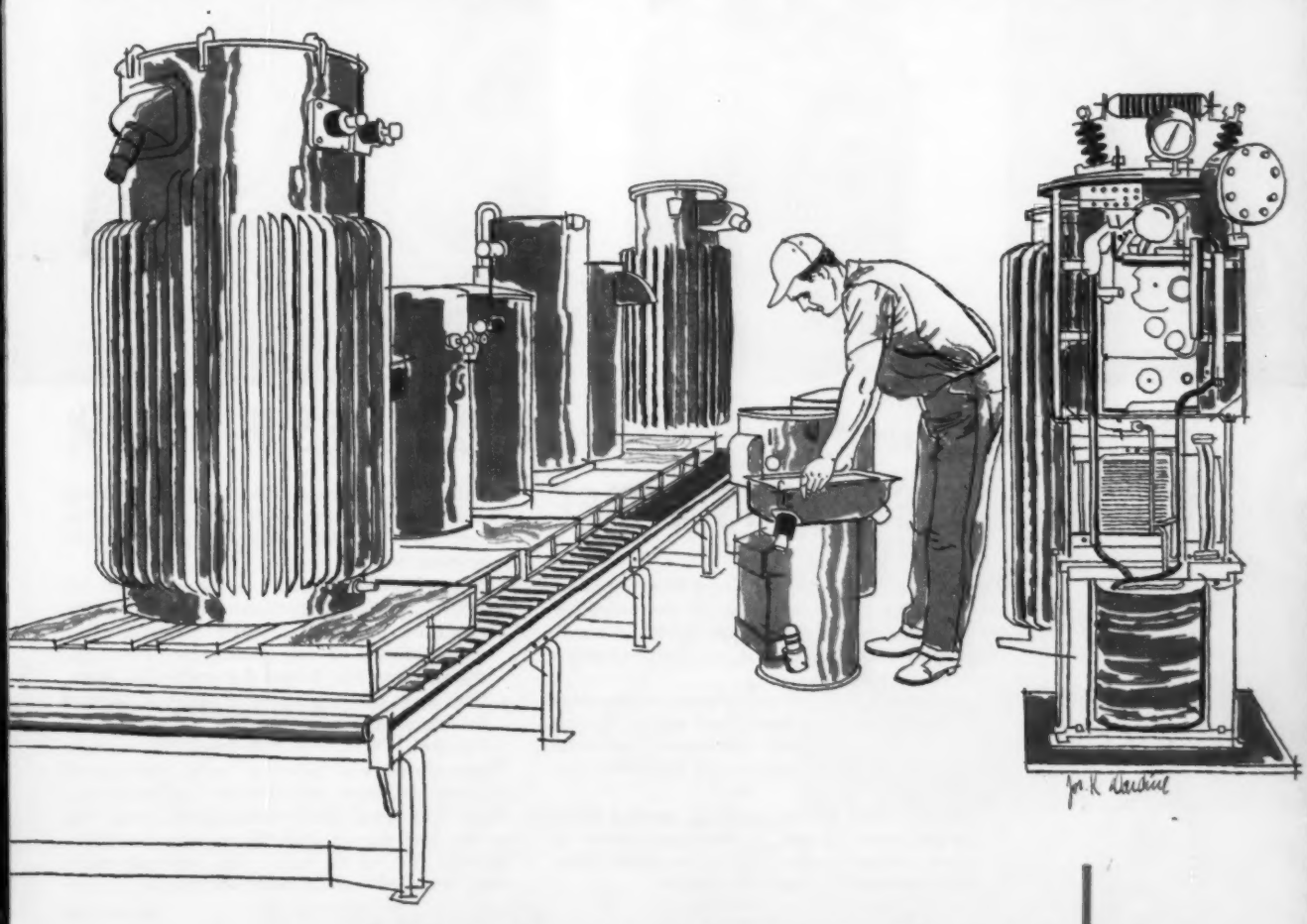
12-58-M

Electrical World
SPECIAL REPORT

DECEMBER 1958

ELECTRIC utility methods

CONSTRUCTION · OPERATION · MAINTENANCE



Assembly Line Speeds Repairs | p 73

Corrosion typical with conventional paints or finishes.

Westinghouse 25-kva distribution transformer with new, exclusive PLASTICLAD cover.

maintenance-free exclusives with new Westinghouse transformer

One glance up a pole at the new Westinghouse transformer tells you most of the story. A story of countless man-hours saved in needless repair and repaint jobs, expensive changeouts and inspections.

The proof? Your Westinghouse representative can show you how four major design advances have virtually eliminated problems of corrosion and erosion of distribution transformers.

1. Forged steel lifting eyebolt, seated in a forged steel I-beam, holds dome cover in place, securely seals it. Forever does away with vulnerable cover hardware.
2. Internally mounted H-V and L-V bushings are secured by spring-grip nuts on threaded porcelain shanks. More exposed parts eliminated.
3. New PLASTICLAD* cover . . . on all Westinghouse transformers with cover-mounted bushings . . . is impervious to acids, alkalis or any other in-service condition. Another target for corrosion gone.
4. The most thorough protection ever applied to transformers, exclusive Westinghouse Coastal Finish, will not crack, flake, rust.

These are days of growing loads, accelerated changeouts, new transformer installations. Have your own purchasing agent bring you up to date on all that Westinghouse transformers can do to bring you welcome relief from crowded maintenance schedules. J-97212

*Trade-Mark

YOU CAN BE SURE...IF IT'S Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV MONDAYS

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330 West 42nd Street
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ELECTRIC
utility methods
DECEMBER 1958

This Issue

Assembly Line Speeds Repairs

About 800 transformers a month are being processed in Commonwealth Edison's repair shops. Use of conveyor belts and monorails speeds up the repair operation. p73

Level and Micrometer Gauges Hot Shaft Alignment

E. A. RUDULPH, Engineer, Union Electric Co., St. Louis, Mo.

Union Electric devises method for measuring shift in turbine-generator shaft while the machine is under load at operating temperature. p76

Divers' Work Preserves Cables

J. E. LOGAN, Logan Diving & Salvage Co., Jacksonville, Fla.

Periodic inspection and repairs forestall corrosion, attrition and extend useful life of submarine equipment. Annual inspections are recommended for major cable crossings. p79

Calibrated Stopwatch Checks Sag

P. C. EVANS, Project Supervisor, B. C. Engineering Co., Ltd., Vancouver, British Columbia

Sags of medium and light conductors can be measured rapidly and economically to 1% accuracy by using a stopwatch calibrated in feet of sag. Device times travel of mechanical wave produced by striking the wire. p82

Reguiar Features

CONSTRUCTION p84
OPERATION AND TESTING p94
MAINTENANCE AND REPAIR p107

New Equipment p62
Safety p117
Books p120
Stores p122
Manufacturers Literature p115

NEW EQUIPMENT

To obtain more information on these New Equipment items, use code numbers indicated for each item when filling in Reader Service form facing page 127

Inspection Jack . . .

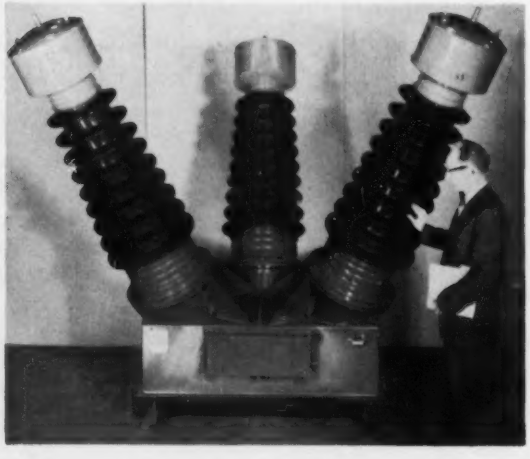
. . . speeds untanking of 3-phase regulators. It allows easy, complete inspection and maintenance of the tap changing mechanism. The jack consists of two hydraulic units rated 5,000 lb each, which can be clamped to the tank braces of Type SFR regulators. An I-beam, attached to the two jacks, lifts the regulator as high as 36 in. Portable, the jack unit can be handled and operated by two men in any location where overhead clearances are 24 in. or more.

Allis-Chalmers Mfg Co, Milwaukee 1, Wis. A1

Potential Transformers . . .

. . . for 3-phase, high-voltage operation are now available. For use with standard voltages above 69 kv, the type APT potential transformers are smaller than conventional combinations of three single-phase units. They are lower in price, and have lower foundation and installation costs than combinations of single-phase units.

Westinghouse Electric Corp, 469 Sharpsville Ave, Sharon, Pa. A2



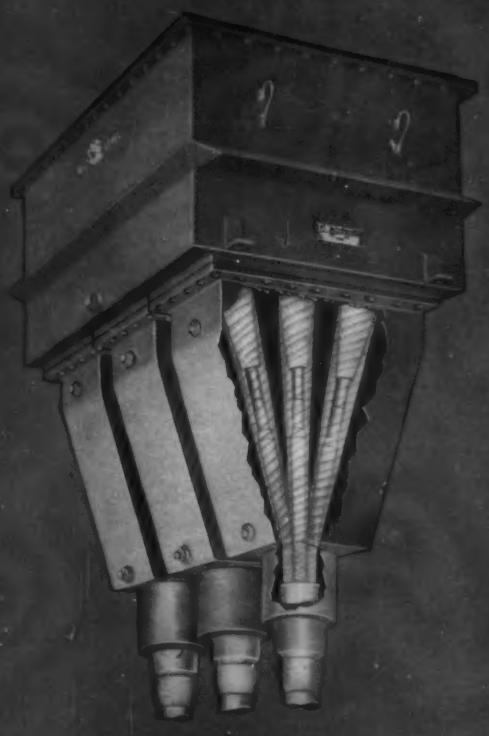
Combination Reel Trailer . . .

. . . converts from real trailer to wire and cable layer in ten minutes. It has a built-in leveling mechanism that allows up to 24 in. difference in wheel elevation. The cutting blade reaches a depth of up to 30 in., and a wide variety of small reels can be carried when the trailer operates as a cable layer. Cable reels as large as 8 ft in diameter may be carried when the device is used as a cable trailer.

F. B. Ryan Mfg Co, Chariton, Iowa A3

(More New Equipment on page 65)

INVESTIGATE THESE REASONS FOR USING OIL FILLED LINK BOXES



FOR CABLES OF ANY SIZE OR VOLTAGE

- Permits sectionalization of circuits (under no-voltage conditions), allowing isolation or grounding of one or more cables
- Point of access for phasing or fault location
- Provides low cost distribution
- Serves as an isolating barrier between cables having different types of insulation
- Serves as a stop joint to reduce internal cable pressures caused by varying elevations of cable routing
- Specialized skill generally required for making wye joints is reduced to normal skill needed for straight joints or pothead installations

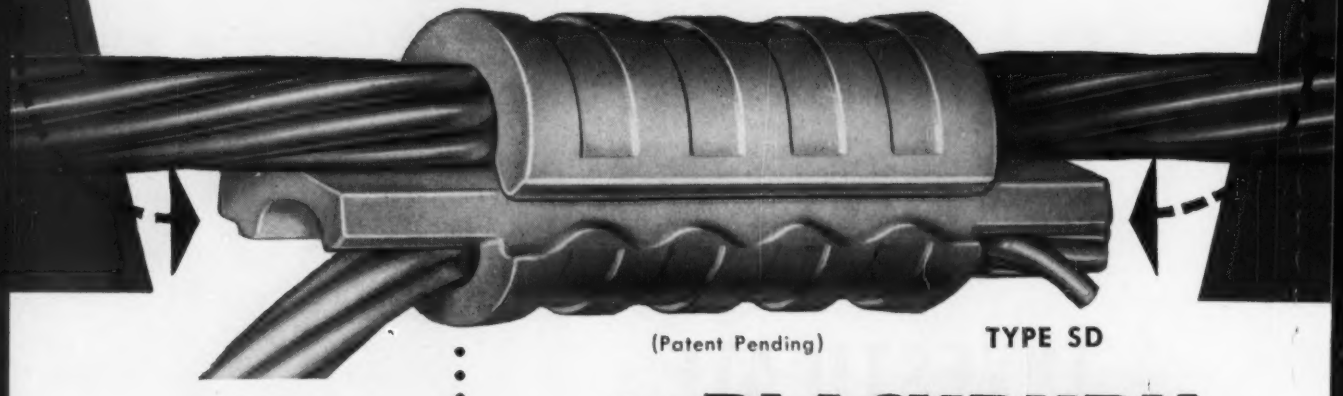
Conduct your investigation through a G&W representative. He will be glad to assist you.

Illustrated above: Oil filled box with gas filled cable-heads and stud bushings—3 way, 3 pole, 34.5 kv, 500 mcm, LPGF cables. (Available also with hermetically sealed potheads—either may be filled with compound, oil or gas.)

G&W ELECTRIC SPECIALTY COMPANY
3300 WEST 127TH STREET • BLUE ISLAND, ILLINOIS
CANADIAN MFR. • POWERLITE DEVICES LTD. • TORONTO, MONTREAL & VANCOUVER

B501

Exclusive New DRIP-GUARD SEPARATOR



(Patent Pending) TYPE SD

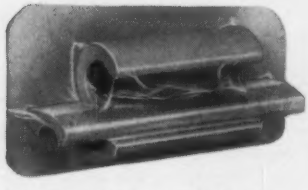
in BLACKBURN 6-Frame Tap Connector

- **Assures Separation of Conductors**
- **Provides Needed *Extra* Protection on Bi-Metallic Connections**

Type SF Recommended for Aluminum to Aluminum

This Blackburn 6-Frame Tap Connector assures complete separation and protection of the conductors. The Drip-Guard is unnecessary for this application.

Both Designs Available *Pre-Filled*

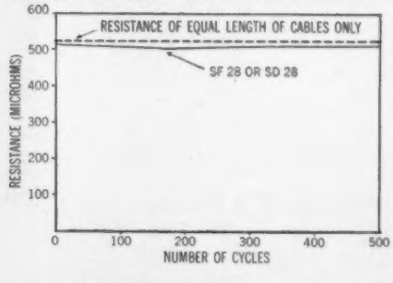


Type SD or SF may be ordered pre-filled with Blackburn's superior oxide-inhibiting compound, Contax. Pre-filling eliminates the possibility of an installation being completed without inhibitor.

Write for samples

LIVE BETTER ELECTRICALLY

CURRENT CYCLING TEST TELLS THE STORY



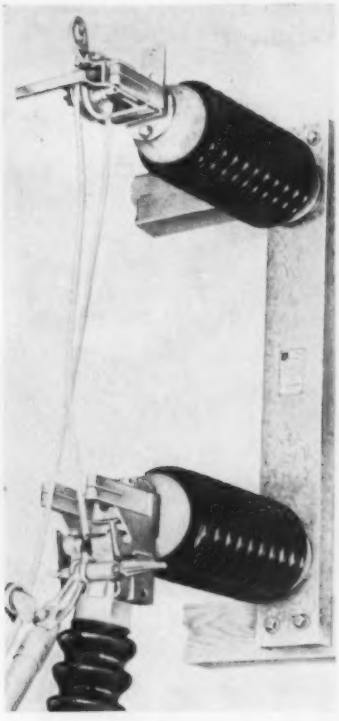
Current Cycling Test Conditions:

1. Cables: 4 Stranded Copper; 2 ACSR.
2. Cable operating temperature: 125° C.
3. Cycle: 2 hours "On", 1 hour "Off".
4. Length of connection: 24 inches.
5. Resistance of equivalent length of wire: 522 microhms.
6. Cables were wire-brushed, but no protective compound was used.
7. Curves represent an average of seven tests.

This rugged Blackburn design provides protection for conductors from both galvanic corrosion and physical damage. The Blackburn Drip-Guard Separator, plus the completely enclosed tap, prevents corrosion products from bridging the gap between the copper and aluminum conductors. Copper wire now can be used as main or tap without corrosion damage to the aluminum conductor.

In addition, the superior Blackburn design, which incorporates external channels parallel to the tap hole, assures uniform encirclement of both conductors when compressed.

Shot-blasted surfaces protected by an oxide-inhibiting film insure oxide-free connectors at jobsite.



Lightweight Fuse Hoist

. . . permits one man to remove fuse holder from outdoor mounting. An aluminum block assembly, carried on a prong, is inserted between upper stationary contacts after fused switch blade is opened. The block is then used for lowering fuse holder to the ground with a neoprene-covered nylon line, which runs through a snubber standing on the pole. Snubber action permits one man to do job.

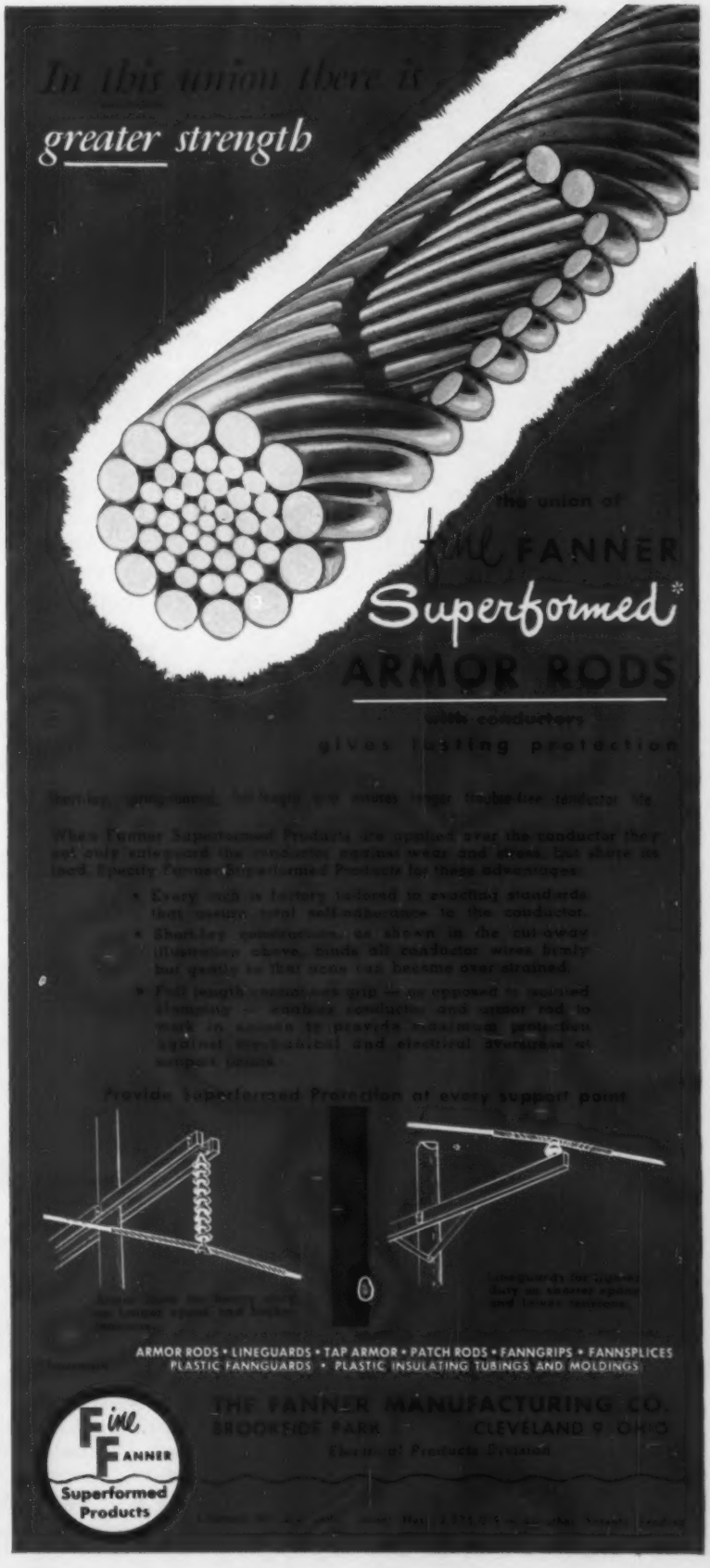
S & C Electric Co, 4435 Ravenswood Ave, Chicago 40, Ill. A4

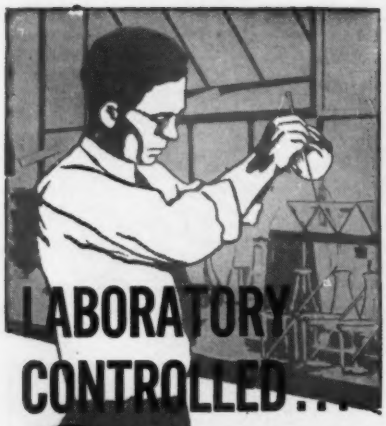
Metal-Clad Switchgear

. . . features walk-in construction affording ease of erection in field. Generous space is provided for withdrawing breakers and testing and adjusting all meters and relays. The construction is available for single line-up, or face-to-face installation with a common aisle for any low-voltage, 4160-v or 13.8-kv switchgear assembly.

I-T-E Circuit Breaker Co, Philadelphia 30, Pa. A5

(More New Equipment on page 66)





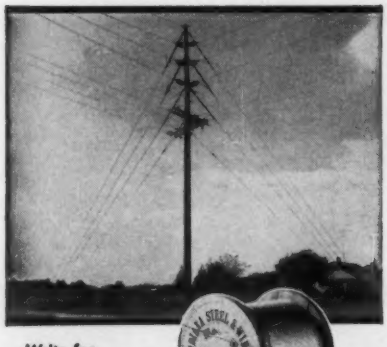
LABORATORY CONTROLLED . . .

Crapo

GALVANIZED STEEL STRAND FOR GUY, MESSENGER and OVERHEAD GROUND WIRE

The high, uniform, consistently-dependable quality of Crapo Galvanized Steel Strand is the direct result of close laboratory control over each step in manufacture. All wires used in forming a particular size and grade are produced from steel of selected analysis, carefully processed under technical supervision and stranded on precision machines. Both wire and finished strand are subjected to prescribed laboratory tests to insure the desired end result.

Heavy, uniform, tightly-bonded zinc coatings, applied by the famous Crapo Galvanizing Process, provide maximum resistance to corrosion.



Write for booklet OG-25 containing "Sag and Tension Data for Overhead Ground Wire."

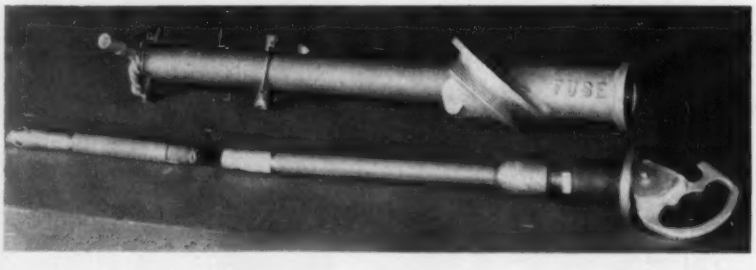
INDIANA

STEEL & WIRE CO., INC., Muncie, Indiana

Silicone Spray . . .

. . . protects insulators against contaminants. It quickly sheds water droplets, encapsulates the contamination particles in a moisture-proof seal, and eliminates the occurrence of low resistance paths for leakage current. The spray, known as Insuljel, may be applied to hot lines. Lines may be resprayed without removing contaminant-saturated coatings.

General Electric Co, Box 57, Baltimore 3, Md. A6



Bayonet Type Fuse . . .

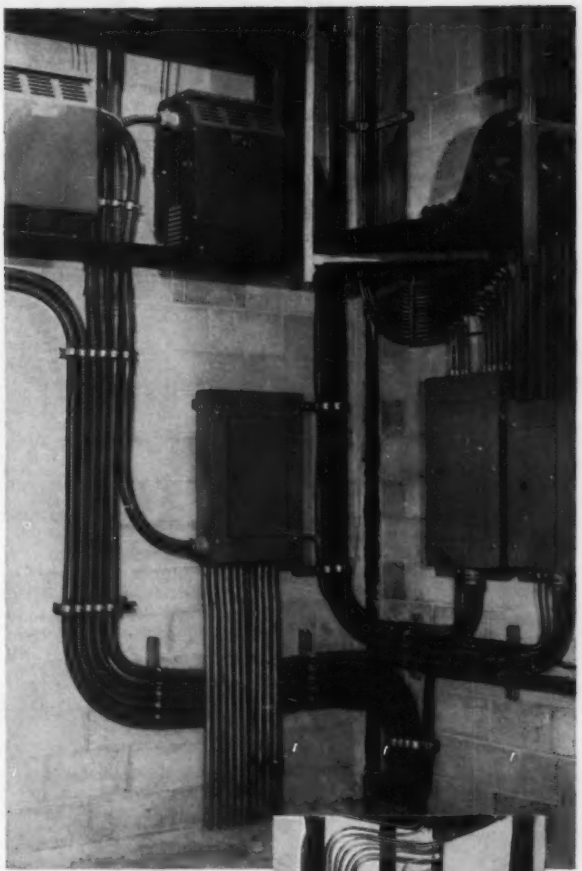
. . . is externally operable and can be inserted in or removed from the transformer with a hook stick. Developed specifically for use with the manufacturer's "Terra-Tran" transformers, the bayonet fuse is below oil level when fully inserted in its holder. The fuse link cartridge is removable from the fuse assembly. Interchangeable fuse links are available for each kva rating from 10 through 100 kva and generally have a minimum blowing current of 20 times transformer full load current.

R T & E Corp, 1900 E North St, Waukesha, Wis. A7

(More New Equipment on page 68)

the right combination for power needs!

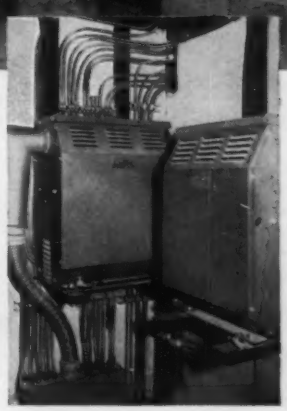
Only General Cable manufactures both...



Installation at the St. Regis Paper Company, Jacksonville, Fla. plant.

TYPE M.I. CABLE

for distribution, control and lighting circuits



INTERLOCKING ARMORED CABLE

for primary power feeder circuits

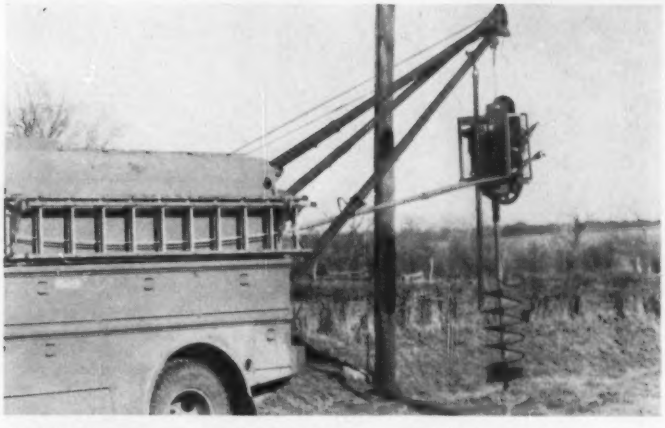
Easy to install in all locations, both Safety M I Cable and Interlocking Armored Cable require no mechanical protection, thus lowering costs of installation and minimizing space requirements. These constructions are easy to train around equipment or structural members, assuring the absolute minimum of interference, and present a neat, functional appearance. In addition, Safety M I Cable has unequalled physical and electrical properties: it is completely resistant to moisture, aging, nearly all chemicals, and operates at continuous high temperatures. For truly modern wiring in your plant, specify Safety M I Cable and Interlocking Armored Cable. And remember; only General Cable makes them both.

GENERAL CABLE CORPORATION 420 Lexington Avenue, New York 17, N. Y.
Offices and Distributing Centers Coast-to-Coast

for quality and service... **specify GENERAL CABLE**

You'll save a lot of time with . .

F & H Self-Powered HOLE DIGGER

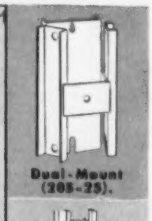


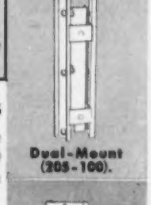
★ The modern way to dig holes. No expensive installation. Fits on any A frame. Equipped to dig holes 8' deep and up to 20" in diameter. One man operates digger as all controls are mounted on machine. Available in 9-HP and 18-HP models. Auger is cleaned by spinning. Digs anchor holes with ease. Write for full information. Film of machine in operation available on request.

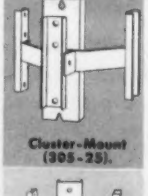
Manufactured by **FOUSHEE & HECKENDORN**

***Telephone:* BRoadway 4-3745 • CEDAR POINT, KANSAS**

Cluster Mount Transformers Quickly . . . Easily . . . Securely . . . with TECO thru-bolt Mounting Brackets







Cluster mounting two or more transformers is no problem with TECO thru-bolt cluster mounting brackets.

Transformers can be bolted to brackets with majority of connections made on ground and then hoisted into place—all in half the time required to install a band-type cluster rack.

When you consider cluster transformer mounting brackets, remember that TECO offers you;

Safer, more secure installation with thru-bolt mountings. Brackets are of hot galvanized one-piece welded construction. Key hole and slots provide ease of installation. All TECO brackets have a two to one safety factor.

No parts to lose—no complicated assembly.

Safety for linemen. Plastic cap over head of bolt eliminates possibility of ground contact.

Easier storage. TECO cluster mounting brackets can be stacked on top of each other—require only a minimum of storage space.

For more information about TECO thru-bolt brackets—your best answer for cluster transformer mounting-write today to:

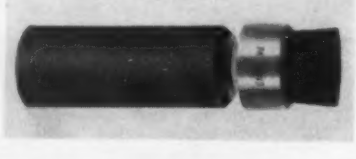
TURNER ELECTRIC CORP.
9510 St. Clair Avenue • E. St. Louis, Illinois

Complete line of air-break switches, dead-end band brackets, flexi-band and thru-bolt cluster transformer brackets.

Watthour-Meter Tester . . .

. . . features phantom loading apparatus for loading meters under test at light load and full load up to 50 amp. Eleven current and five potential ranges are provided. Provisions are included for testing the 30-amp, single-phase extended range meters now being installed. All components, including the meter under test, are adequately grounded. Switching arrangements permit testing of 3-element polyphase meters as well as the 2-element type without manually changing connections.

Knopp, Inc, 1307 66th St, Oakland 8, Cal. A8



Brush Applicator . . .

. . . permits easy application of oxide inhibitor to aluminum or bimetallic connections. The brush is mounted on a plastic squeeze bottle, which is easily replaced when empty. Use of the applicator helps prevent soiling of gloves and clothes. The brush is quickly cleaned by saturating with any solvent, then wiping out with cloth or paper.

Utilities Service Co, Allentown, Pa. A9

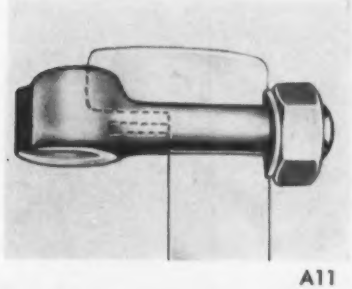
Cable Clamp . . .

. . . provides a quick way of attaching a load to a continuous cable. The fitting consists of a wedge clamp, wedge and cable clip. To attach the load to the cable, the wedge clamp is placed

on the cable with the small end in the direction of the cable pull. The wedge is then inserted. A clevis and pin are often used to attach the load to the clamp. Clamps are manufactured for rope sizes from ⅜ to 1¼ in.
Sauerman Bros, Inc, 620 S 28th Ave, Bellwood, Ill. A10

Skinning Knife . . .

. . . is designed to skin neoprene and polythylene-covered wire. The penetration-limiting attachment may be used on 2/0 to 4/0 wire. The adjustment is screw set according to insulation thickness. The knife and attachment are sold as a complete unit with blade replacements available.
Miller Equipment Co, Franklin, Pa.



A11

(More New Equipment on page 70)

"Treat 'em right and they'll last for years"

One of the slickest devices to come along in some time, especially for street light controls, is the cadmium sulfide photocell. But like anything else, what you get out of it depends pretty much on what you put in, by way of application care and common sense. Here are some things we've learned over the last four years, trying to get maximum reliability in a new control built around a CdS cell.

Running a CdS cell on *AC* calls for a relay with better-than-average sensitivity and precision, and this has caused some to sidestep the problem by using a DC relay in a DC circuit. But then the combination of the DC and the high light levels involved gives the cells a kind of electrically lopsided personality, making drift a real problem. We've stuck to AC, and our affiliate company has answered the relay question by designing one especially for the job.

You also have to keep close tabs on *how much power* a CdS cell is required to dissipate. Boosting dissipation but a fraction of a watt over the cell's rating (in control circuits, at room temperature) cuts down cell life from a period of years to a few months; on top of this, temperature increases make matters even worse. So in our new 6600A Series controls, dissipation has been held to a conservative minimum.

To give the cells every other operating advantage we could think of, we also buy *average* sensitivity cells because they remain more stable than high sensitivity types; *pre-age* them, to improve their stability still further; use *hermetically sealed* cells to avoid the ravages of humidity; *shield* them from the sure death of sunlight (by designing the control to operate facing north); and insist that they meet rigid specifications when we get them, as insurance against a whole flock of future problems.

We are not saying this is the *only* way you can build a reliable CdS photocell control. But hitching a cell to some kind of switch and dropping a little cover over the works isn't our idea of the way to make street lights turn on and off with certainty, year after year . . . or the way to stay in business, for that matter.

The Fisher-Pierce Co., 82 Pearl Street, So. Braintree 85, Massachusetts.

FP
FISHER PIERCE
PHOTOELECTRIC LIGHTING CONTROLS
AN AFFILIATE OF SIGMA INSTRUMENTS, INC.

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WHY GUESS?.. TELL TRANSFORMER POLARITY... INSTANTLY!

DICE POLARITY TESTER

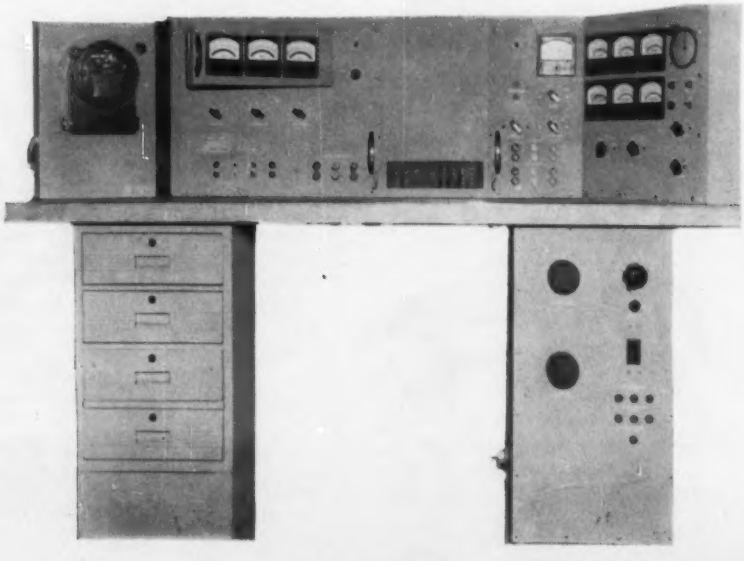
Checks all power and distribution transformers . . . through type and split core current transformers.
Self-contained power supply.
Ruggedly built for field, shop use.

J.W.DICE CO. ENGLEWOOD, N.J.

Cast Steel Cable Bridge . . .

. . . protects electric cables, air hoses and fire hoses up to 3 in. in diameter. Intergrally cast interlocking means are provided at each end of the bridge to permit assembly of any number of units. No tools are required to assemble the units, and no pins are necessary. The cast steel bridge may also be used as a permanent traffic divider. Bridges for 3-in. hose or electric cable are 16 in. long and weigh 32 lb. They will withstand pressure of the weight of the heaviest trucks.

Calumet Steel Castings Corp, 1636 Summer St, Hammond, Ind.
A13



Trencher . . .

. . . is only 5 ft 10 in. high, but maintains all advantages of larger models. The ladder-type machine, known as the Parsons No. 77 "Trench-liner", digs to a 5-ft depth at 6 to 18-in. widths. Four speeds of the self-cleaning bucket line range from a 38.5-fpm minimum to a 246-fpm maximum. Conveyer is shiftable and reversible so that soil can be deposited on either side of the trench. Boom is telescopic type and can be elongated for use at a variety of depths.

Parsons Div, Koering Co, Newton, Iowa A12

Bench Test Set . . .

. . . tests all types of network relays made by major manufacturers. Metering includes multirange ammeters and voltmeters for each phase, with provisions for range switching under load. All meters have accuracy of 1% at full scale, with mirror scale and knife edge pointers. Plug-in adapters are used for each type of master and phasing network relay, facilitating both standard and repetitive tests and reducing set-up time. Lower right section contains power supply and necessary controls. Lower left section provides storage space.

Multi-Amp Corp, 465 Lehigh Ave, Union, N. J. A14 ◀

For the long haul

guy with

CF&I GALVANIZED STEEL STRAND

Stringing lines over woodlands or difficult terrain is an expensive initial operation. But maintainance, too, can be costly unless the guy and messenger wires have the strength to withstand severe storms and the corrosion-resistance to assure long, trouble-free service.

To meet these requirements, CF&I carefully controls every step in drawing, galvanizing and stranding its Galvanized Steel Strand. Extreme care in cleaning and galvanizing produces a heavy, tightly-bonded coating of pure zinc that provides maximum protection against corrosion. CF&I Strand meets or exceeds ASTM Specifications A-122 or A-363, or can be made to meet customer specifications in seven- and three-wire constructions.

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Allis-Chalmers Core and Coil Assemblies Make Distribution Transformers

Better 'n New in 4 simple steps

1

After cutting leads to required length, braze terminals to leads.

2

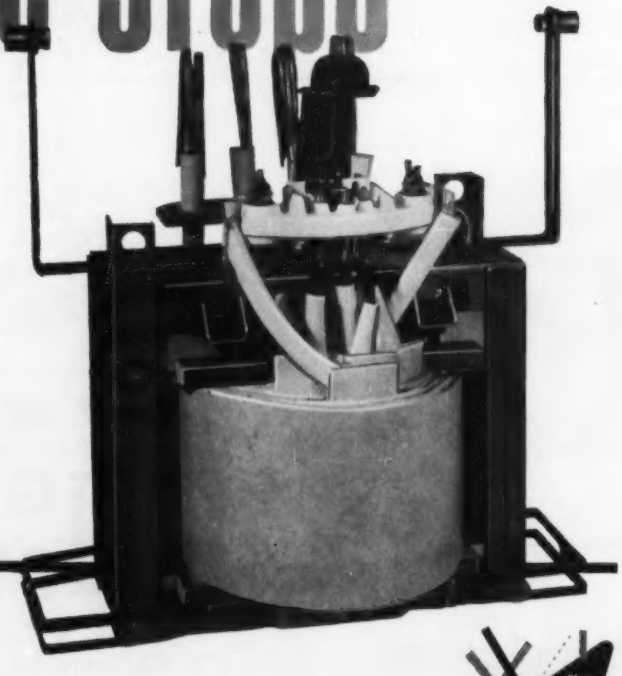
Attach brackets to top and bottom of end frame, using bolts in frame.

3

Position assembly over tank. Adjust bottom brackets to assure snug fit.

4

Lower assembly into tank and adjust top brackets to meet lugs in side wall. Anchor in place.



Increase Kva Ratings Up to 100%

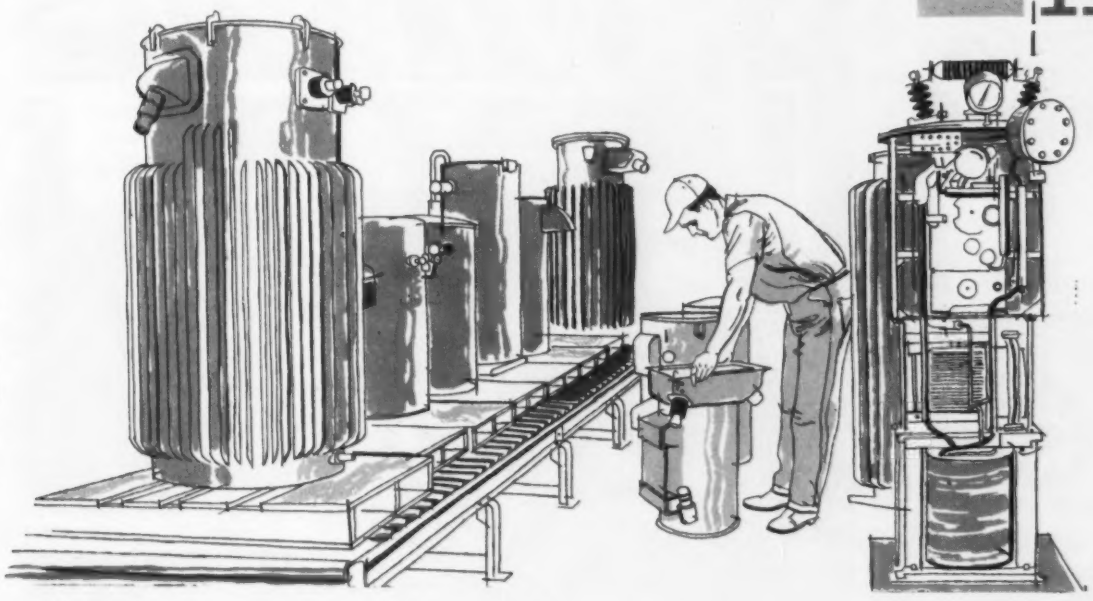
Yes, better 'n new! Replacing worn out cores and coils with Allis-Chalmers assemblies not only salvages service years but up-rates kva by as much as 100%.

These are completely new units featuring the same craftsmanship, high grade materials and quality control that have made Allis-Chalmers transformers preferred equipment. Assemblies are available in ratings 25 kva and smaller, 15 kv and below. They may be used in any make tank in either convéntional or protected types. Provision for mounting low voltage breaker and a winding to operate signal light are standard. Oil-immersed in specially designed damage-proof containers, assemblies arrive in perfect condition.

For complete information, call your Allis-Chalmers representative or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-5879

ALLIS-CHALMERS



Assembly Line Speeds Repairs

About 800 transformers a month are being processed in Commonwealth Edison's repair shops. Use of conveyor and monorails speeds up operation

Transformer repairs at Commonwealth Edison Co's shop have been put on an assembly-line basis, handling facilities being designed for processing 800 transformers a month, 10,000 a year.

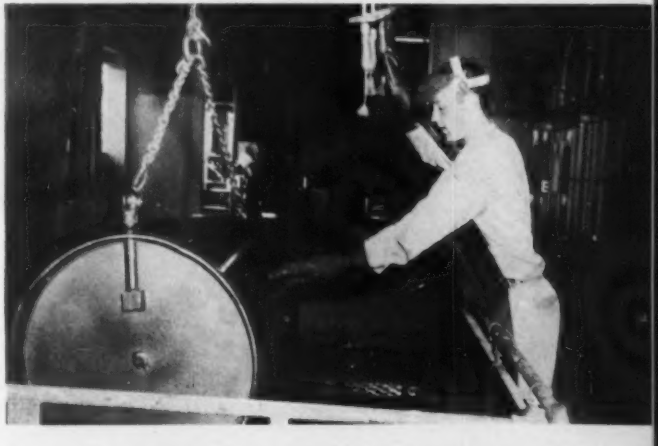
Transformers come to the shop by truck. Only those not in condition to go back in service without repairs are brought there. Yet, all transformers are put through the same general overhaul.

As transformers are unloaded they are placed on a roller conveyor which takes them into the shop. They are picked up there by monorail and moved a few feet to a grating where oil is drained. The oil is caught and directed to a salvage tank.

Cores and coils are then removed from the tanks and take one route while the tanks take another, until they meet again in the assembly area.

The tanks move first to the chipping area where all bushings are removed. From there they go to the cleaning tank where they are dipped in a boiling cleaning solution. They move on to the rinse booth, where dirt and oil loosened by the cleaning solution are rinsed off the tanks along with the cleaning solution. Tanks are then removed from the monorail and welded or repaired if necessary.

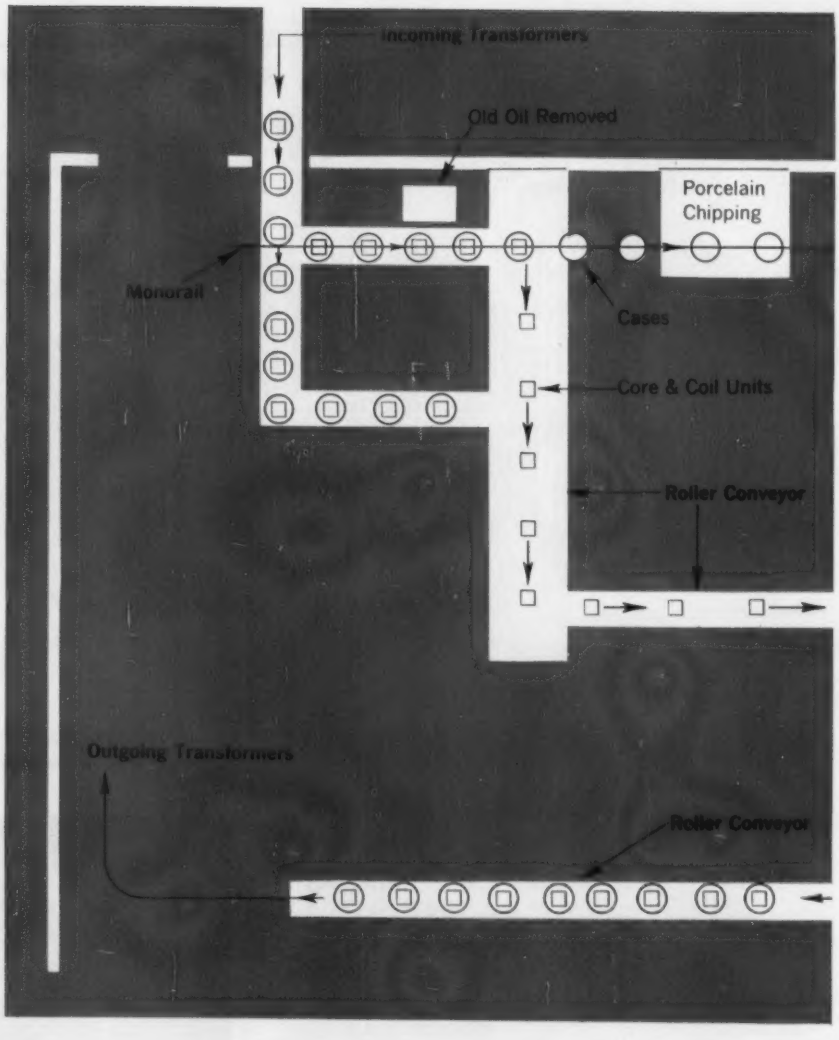
When no repairs are needed, or after the tanks have been repaired, they are placed on a conveyor which takes them to the spray painting booth. They



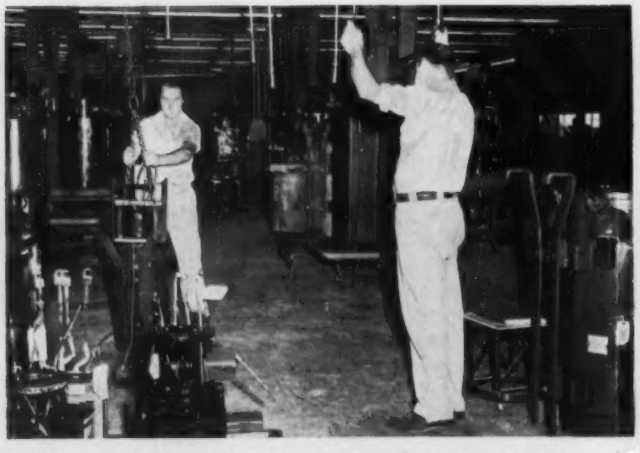
TRANSFORMER TANKS are dipped in cleaning solution to remove grease and dirt. They are then sprayed with paint as they pass along on the conveyor. From the spray painting booth, the tanks go to an electric oven

TRANSFORMER REPAIR SHOP

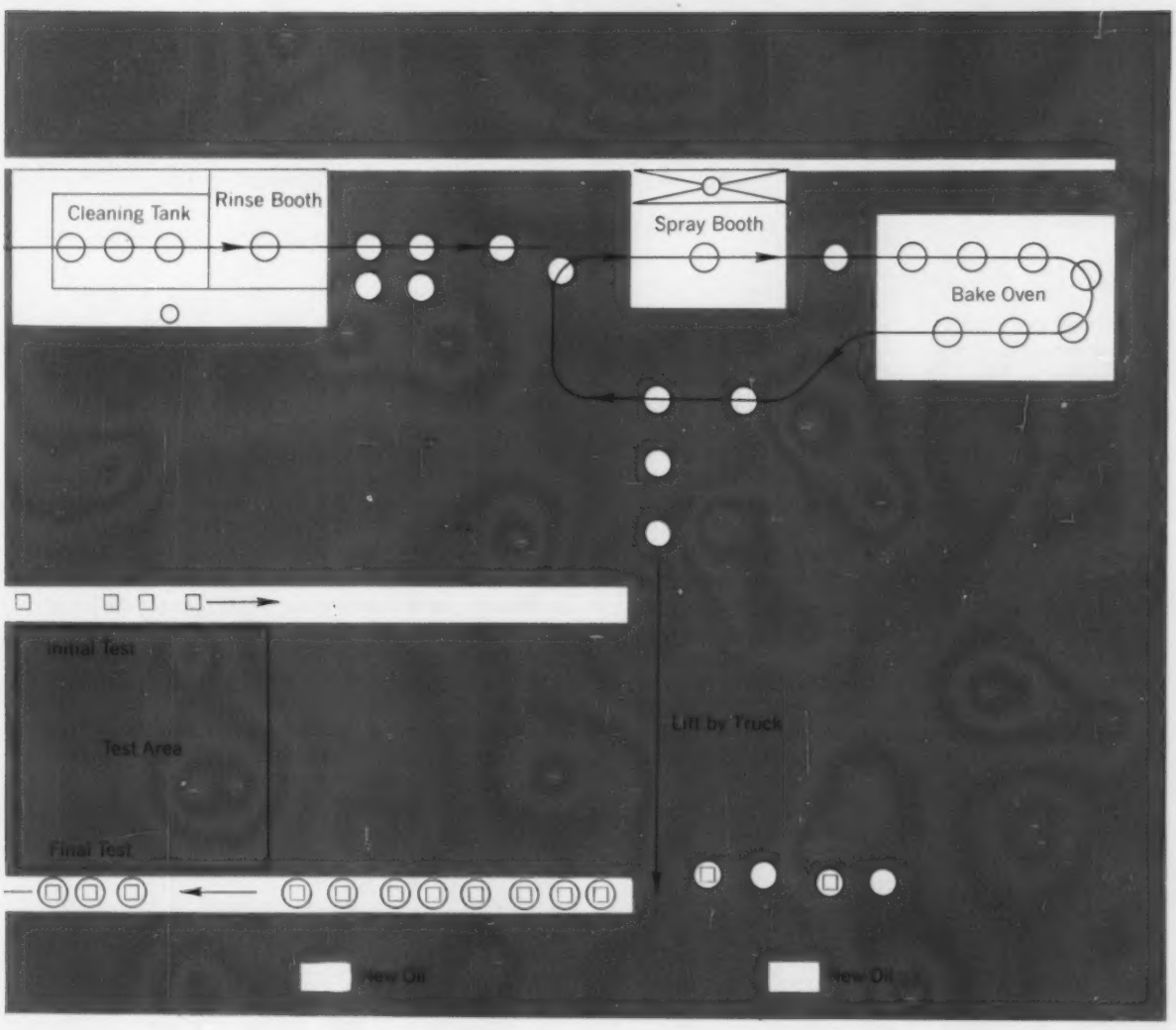
operations have been put on an assembly line basis for processing up to 10,000 units a year. A roller conveyor, monorail, and the organization of various areas for special processing are parts of streamlined operation



CORES AND COILS are placed in pans to prevent oil from dripping as they move along the conveyor line in the shop



ONLY FINAL TESTS and stenciling remain after the core and coils are re-installed in the tanks in the assembly area



are painted as they pass. Speed of the conveyor can be varied from 1 to 3 ft per min. Tanks leave the spray painting booth on the conveyor and pass into the electric oven, where the paint is baked. From the oven they return to the spray painting booth for the second coat, and then again to the electric oven to bake the second coat. When tanks come out of the oven the second time they are removed from the conveyor and taken by lift truck to the assembly area.

Coils removed from tanks are placed in pans to prevent dripping of the oil. The pans move on a roller conveyor to the test area. There connections are made, and the operator moves to the test bench where, by operating switches, he makes the required tests. Initial tests include a dc insulation resistance test and 400 cps induced potential test to detect faults between turns. The secondary circuit breakers on CSP transformers are given calibration tests. The 60-cps applied potential test voltage varies with the primary voltage rating of the transformer being tested.

The initial tests completed, the coils pass out of the test area on the roller conveyor and are taken by lift truck to the assembly area. There the coils are returned to tanks, bushings are re-installed, and the transformers are completely reassembled and put on fork lift truck pallets which are on another roller conveyor. Tanks are filled with oil, and the assembled transformers pass back through the test area for final tests.

After final tests, the transformers pass out of the test area on the roller conveyor. Gasketing material is ejected from a gun and positioned on the transformer cover. The cover is placed on the transformer which continues along the roller conveyor where the size is stenciled on the tank. A fork lift truck takes the transformer out of the building for loading on trucks which take them to the division transformer stock centers. ◂

Level and Micrometer Gauges Hot

Union Electric devises method for measuring shift in turbine-generator shaft while the machine is under load at operating temperature

E. A. RUDULPH, Engineer, Union Electric Co, St. Louis, Mo.

An engineer's level and a machinist's micrometer are combined in Union Electric Co's revised method of checking turbine-generator alignment. Checking is done while the machine is under load and at operating temperatures. The method was devised by company engineers when they were convinced that many mysterious performance difficulties were attributable to changes in alignment after the cold machine had begun to operate.

Machine alignment is now determined by establishing the elevation of a series of points along the shaft's centerline, these findings determining the amount of shimming required once the machine has been taken out of service for overhaul. The measurements also make possible a certain degree of precompensation for machine changes. Substantial mutations in concrete foundations, due to settlement and unequal temperature changes, have been spotted through it.

The level used is the tilting dumpy sort, whose accuracy can be controlled within about 1 sec of arc subtending about 0.001 in. on a radius of about 17 ft. The distance being small, refraction, difraction, and other optical refinements can be dispensed with. This level has these desirable features:

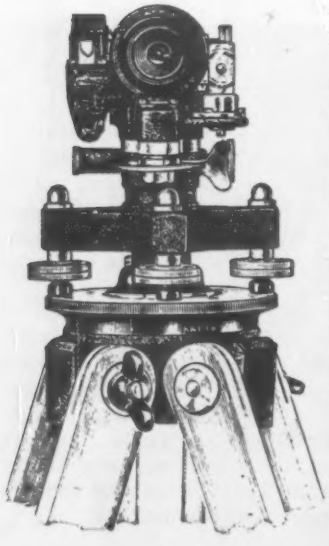
1. Its tilting axis is in a horizontal line intersecting the centerline of the vertical spindle. Thus tilting does not change elevation of bubble tube's center.

2. The bubble can be centered to a high degree of accuracy by means of a micrometer adjusting screw which the observer regulates with only a slight movement of his eye from the telescope's eye-piece.

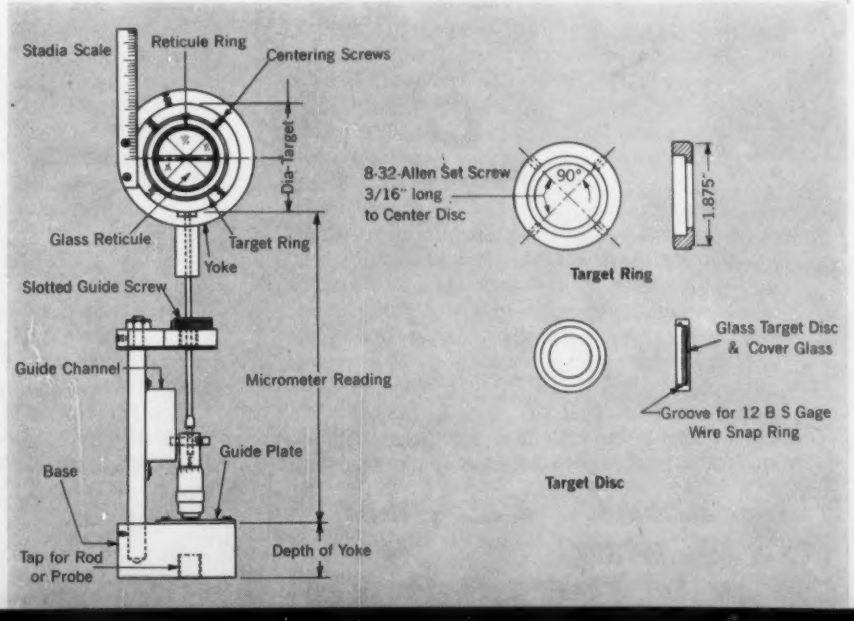
3. An optical device permits the bubble to be centered by the coincidence of half images of the opposed ends of the bubble. Such coincidence can be established so precisely that the centering of the bubble is accomplished within less than 1 sec of arc.

The instrument's optical micrometer can be fitted over the telescope's object to alter the line-of-sight vertically. Such changes take place through distances of ± 0.100 in. in increments of 0.001 in. without affecting the instrument's horizontality. A glass optical flat is so tilted that the light beam is refracted equally upon entering and leaving. Such double refraction results in a parallel displacement of the ray, a feature obviating extremely fine adjustment in setting the instrument. Thus readings can be taken with a micrometer adjustable target on the reference point only and on a fixed target on the unknown point.

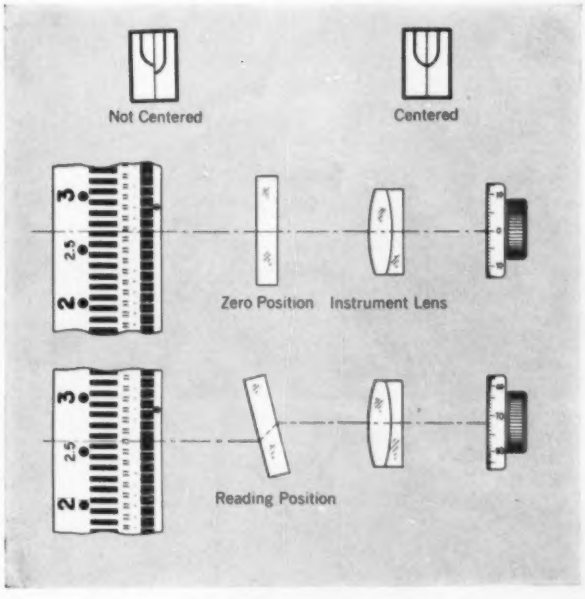
The special target can be centered on the instrument's cross-hairs with a precision equal to the instrument's. Target ring is supported in a yoke, the stem of the inside micrometer bearing on the ring. Changes in elevation can be measured by adjusting and reading the inside micrometer. This pattern can be centered on the crosswires at a distance of 15 ft

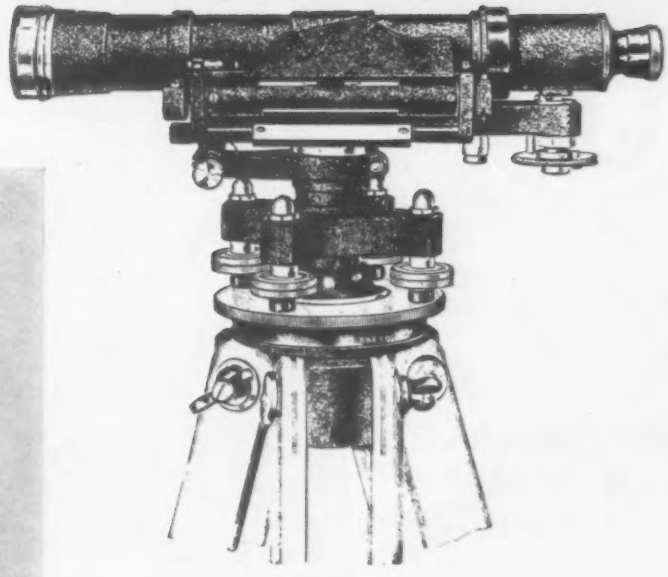


SPECIAL TARGET can be centered on the cross-hairs of the level with a precision equal to the instrument's. It is set on a probe which reaches points on shaft



Shaft Alignment





ENGINEER'S LEVEL is used with optical micrometer in determining elevation of points on the shaft. Level accuracy can be controlled within 1 sec of arc. The function of the instrument lens is illustrated in the drawing at left

with variations of not more than ±0.001 in. A stadia scale gauges distances between the level and target.

The target is set on a probe which reaches selected points on the shaft when the machine is assembled. On new machines the points are selected during erection, and sometimes the manufacturer is asked to provide suitable access openings protected by pipe plugs. The points may be reached through a hole in the top of the cap over a bearing, or where the shaft comes through the bearing seals or the turning gear housing. The shaft may be reached also by removing shaft vibration indicator pickups.

Frequently, a straightedge is used to reach the end of the generator shaft near the exciter housing. The guide for the probe is then installed in the place of a vibration pickup, the hole in the guide being centered above the shaft's vertical centerline. The probe slips through loosely until it rests on the shaft where the vibration pickup shoe usually rides.

Length of the probe from the target's centerline to the tip resting on the shaft is measured to the nearest 0.001 in. Although the measurement can be taken while the machine rotates on the turning gear, it is more convenient to set up reference points on the machine frame which bear a fixed relationship to the shaft. Such reference points permit checks when the unit is operating either at normal speed or under load. As measurements are within 0.001 in., targets cannot be held in the hand. Supports, such as probe guides, are used.

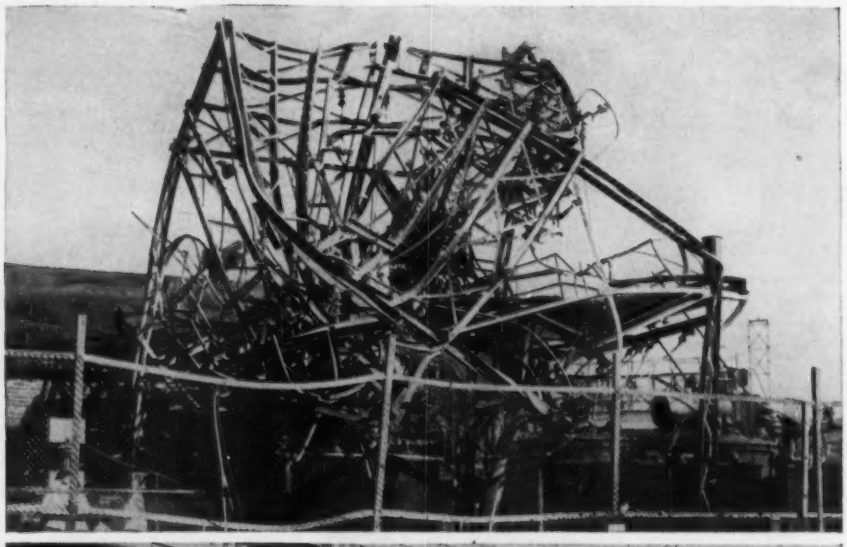
For determining elevations of points on the shaft or of reference points, the level is set up on an elevating pedestal where it can be adjusted conveniently to a desired height. The target assembly is set over the point to be checked and bolted to the machine frame or held by magnets in a vertical position, the probe's end resting on the shaft or reference point. The instrument's height is adjusted until the line-of-sight coincides with the target's centerline. As the length of the probe and diameter of the shaft, or the relationship of the reference point to the shaft, are known, elevation of the point on the shaft's centerline can be determined.

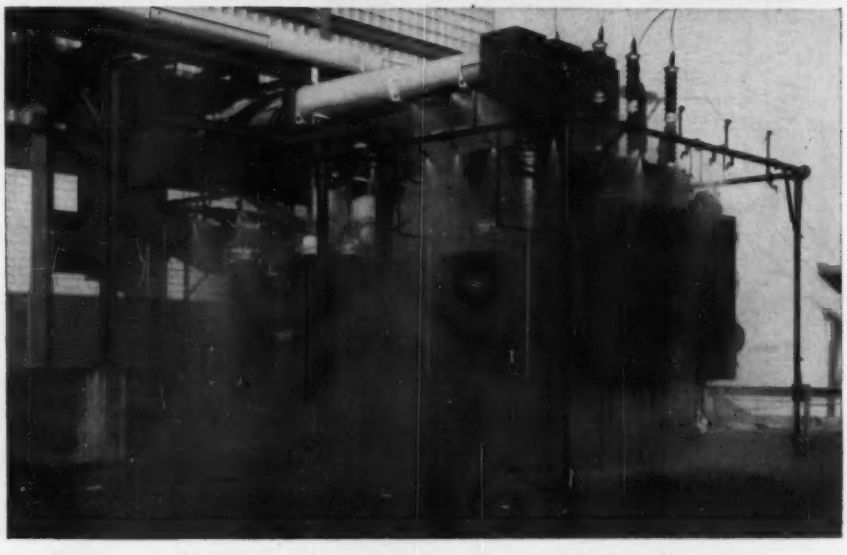
The level is then swung to the target on a common reference point or bench mark. Target and micrometer are mounted on a heavy probe rod of invar steel, length of nonadjustable parts being known. The rod, made up of 10-in. sections, is free to move vertically, the supporting stand only holding it plumb. When the micrometer is adjusted, the target being centered on the level's crosswires, readings are taken. Three consecutive readings are taken by centering on the target three times after the instrument has been thrown out of center by an arbitrary movement of micrometer. Readings must agree within 0.001 in.

The difference in elevation between two points is the difference between two rod readings on the targets at the same distance from the level. As these relationships occur rarely, instrument error is calculated to establish the relationship between elevations of the two points.

Although the level is highly accurate, it is almost impossible to adjust it so that the line-of-sight and the axis of the bubble tube are precisely parallel. Adjustment as fine as 0.001 in. in 17 ft cannot be expected. Accordingly, the amount of error is determined by the four-peg check method, and readings are corrected for the error. ◄

special hazard fires...





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Fairly commonplace in industry today are special hazard areas, where special protection must be provided to assure against possible serious loss by fire. Grinnell, with 88 years' experience protecting against fire hazards of every description, has the most effective extinguishing agents and best systems for each type of hazard.

Remember, too, the installation of the proper Grinnell System usually serves to reduce fire insurance premiums drastically, often pays for itself in a few years!

FREE REFERENCE MANUAL! This new 44-page reference manual — "Special Hazard Fire Protection by Grinnell" — gives you a comprehensive picture of all the most advanced methods for Special Hazard fire protection. It includes explanations, applications, photographs, case histories of Grinnell systems and specialized equipment . . . and a Quick Selector Chart to help you determine the most effective system for your special fire hazard.

Write for your complimentary copy today. Grinnell Company, Inc., 277 West Exchange St., Providence, R. I.

TABLE OF CONTENTS

- Recognizing Your Special Hazards
- The Fire Triangle in Special Hazard Fire Protection
- Special Hazard Fire Terms Defined
- Water Spray Systems
- Selfcon Water Spray Systems
- Foam Systems
- Carbon Dioxide Systems
- Dry Chemical Systems
- Control Equipment and Devices
- Quick Selector Chart
- Research and Testing
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GRINNELL

WHENEVER FIRE PROTECTION IS INVOLVED

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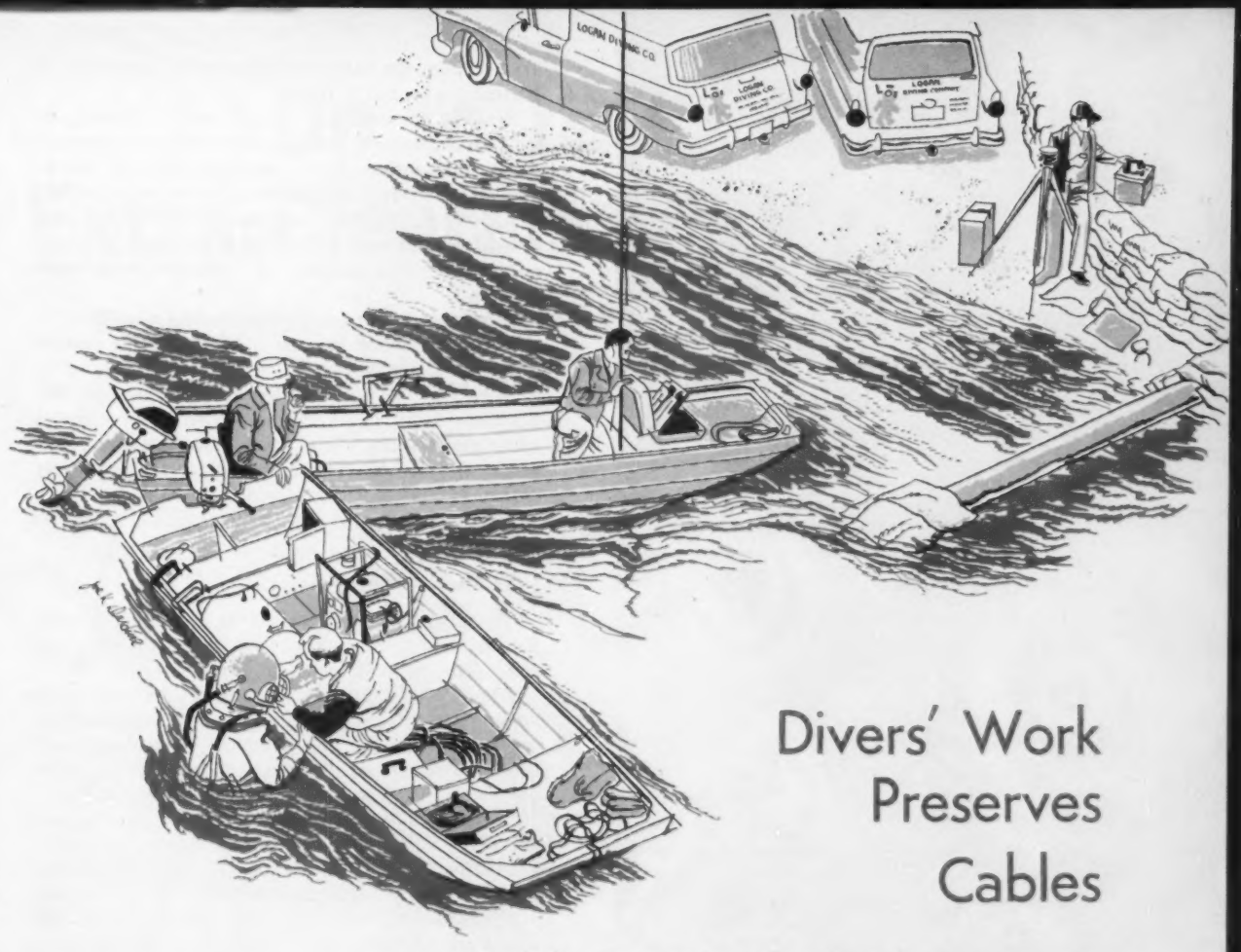


Divers' Work Preserves Cables

Periodic inspection and repairs forestall corrosion, attrition and extend useful life of submarine equipment

J. E. LOGAN, Logan Diving & Salvage Co., Jacksonville, Fla.

Preventive maintenance prolongs the use of submarine cable by assuring that the cable is protected from mechanical and corrosive forces. A program of preventive maintenance starts with underwater inspection before the cable or pipe trench is backfilled. Although this inspection goes a long way toward assuring long life, periodic inspections are needed as river currents and bottom conditions change over the years.

During an inspection, the diver may discover such sources of trouble as exposed cable, suspended spans, debris hooked on to cable, the effects of sand abrasion and corrosion, and kinks. After the diver repairs any damage he finds, the cable is either buried or completely encased in a protective covering of sacks of cement. This covering prevents the damage from widening.

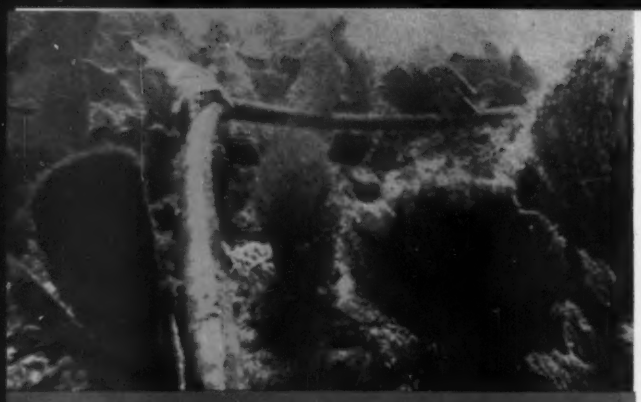
The first inspection of a submersed cable or pipe should be made immediately after it is placed in the trench, before the backfilling. A diver descends along the cable and follows it to the opposite shore, carefully ascertaining whether the cable rests on the trench bottom and the condition of its covering.

During the inspection, the diver holds the end of a steel tape to the pipe while topside assistants record the depth and a transitman ashore records locations. The resulting plan and profile are helpful for future periodic inspections.

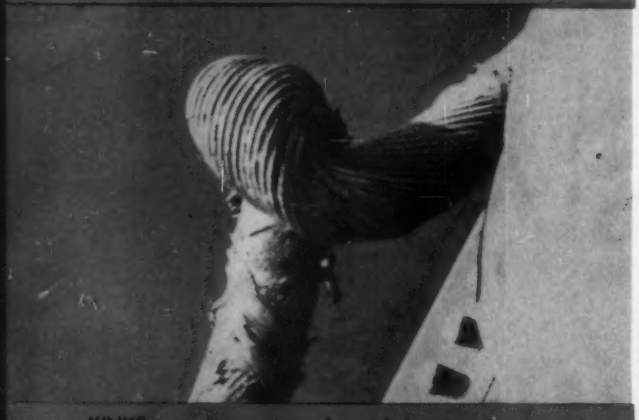
During the first inspection, stream characteristics are studied as a basis for determining the frequency of periodic inspections. Annual inspections are recommended for major cable crossings where banks and river beds are subject to scouring and for all crossings beneath draw spans of bridges. Longer inspection periods may be allowed for stream beds that are of rock or do not shift.

During the periodic inspection, a diver traverses the bottom looking for exposed or suspended cable. He reports to an assistant topside, the length and height of each suspended span, the condition of jute wrappings or steel armor, the presence of loops, kinks, and debris accumulated on the cable.

The diver uses such aids as a cable locating instrument, fathometer, 2-way radio, and hand tools.



CABLE, when it becomes exposed under water, can suffer corrosion and attrition characteristic of its ambient



KINKS are often points of rapid deterioration in underwater cable. Once located, remedial measures follow

COVERING of cables is often damaged by boats, and sand or debris impelled by stream movement

CEMENT BANKS are good coverings for underwater cable, preserving it and stabilizing it in moving water

To tie down the horizontal location of the diver at all times, a transit is used.

Periodic inspections reveal some sources of trouble stemming from exposed cable or suspended spans. Suspensions occur generally near the shoreline, where current is stronger and change in bottom elevation sharp. Scouring action, however, may move from one side of the river to the other over a period, thus changing the location of the suspension.

Whenever a cable or pipe is exposed or suspended above the river bottom, one or more of these sources of trouble can occur:

Movement in a suspended span varies with the flexibility of the cable or pipe, length of the exposed cable, and velocity of the water. Currents often have sufficient force to vibrate the cable, causing stress corrosion and work hardening of the lead sheath at the two points of suspension where bending is concentrated.

Sand-Blasting Action Possible

Trees and debris hook onto the cable and increase the effect of stream movement. A damaging strain can result from the accumulation of debris.

Abrasion of the cable covering results from swift flowing currents carrying sharp sand. The sand-blasting action, in time, can completely erode the steel armor or lead sheath. Often this damage is incorrectly attributed to corrosion.

Exposed cables corrode to some extent, depending on the water characteristics, stream bed materials, proximity of other cables, etc. Corrosion is minimized when the cable is buried beneath the bottom.

Kinks are the greatest single factor contributing to failure of submarine cables. Starting out as a slack loop, sometimes left in the cable during installation, the kink develops when force is applied to the cable by debris, dragging boat anchors, etc.

Marine bores have penetrated lead sheaths after gaining admittance through an opening between steel armor wires of a cable exposed above the ground line.

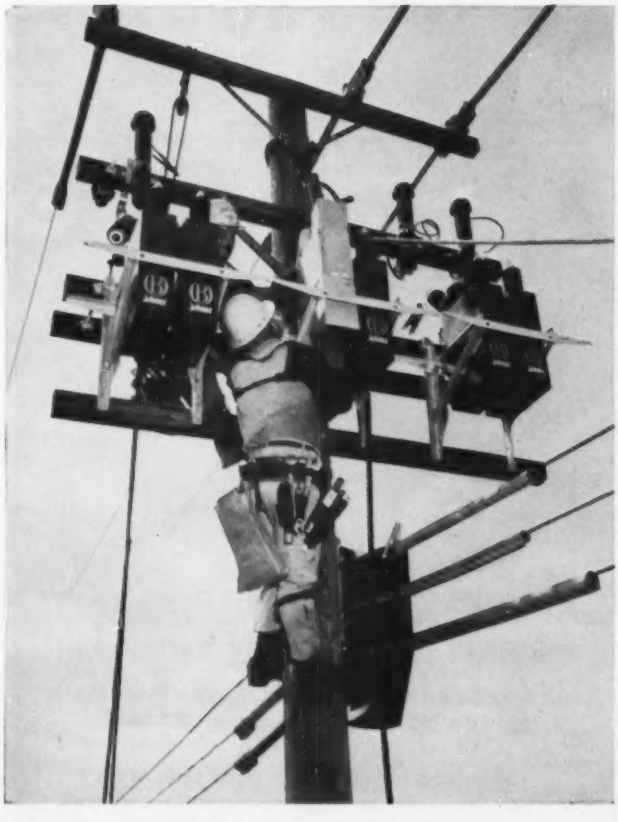
These sources of trouble can be eliminated through two repair methods that correct the ultimate cause, which is the exposed cable or suspended span. In both methods, the cable is covered.

One method involves the use of a water jet to lower the cable below the river bed. But often the cable cannot be lowered because of the consistency of river bed materials and insufficient slack in the cable. Lowering is inadvisable in most cases because the operation places new stresses on the cable which has become set in its present position.

To overcome these limitations, a cement bag method was developed. Burlap bags filled with ⅔ cu ft of dry cement and sand (1:3 mix) are placed under, around, and over the cable along each suspended span. Exposed cables are completely covered. These concrete encasements hold the cable in position and protect it from mechanical forces, without subjecting it to undue forces from a lowering operation. The concrete also acts as an inhibitor to corrosion and induces silting over of the natural river-bed materials. ◄

Up to 12 Inches Extra Clearance at Pole Top

Provided by Low Height of VAREX Capacitor, and Central Lifting Eye



Low height of Varex, plus inches saved by lifting eye location, provides extra clearance, often eliminates need to move primary.

Just a few inches can make a critical difference when capacitors are being installed on distribution lines. To get the necessary clearance for moving the capacitors under the primary and into the rack, it's often necessary to move the primary with hot sticks . . . with a considerable loss in time.

Varex capacitors give you as much as 12 extra inches of clearance at the pole top. Often they can mean the difference between merely covering the primary and the need to move it completely out of the way.

Here's where the difference comes from.

First, Varex 50-KVAR capacitors are as much as five inches lower than other brands.

Second, the Varex lifting eye is centrally located between the bushings. There's no need to put a complicated sling arrangement around the unit. A hook, clevis, shackle, or whatever attaching device you prefer, can go right down between the bushings. The result: a gain of another six to eight inches in clearance.

It's obvious that designers of Varex capacitors understood your installation problems. Everything has been done to make installation fast and easy.

OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass

Central lifting eye lets capacitor hang straight, making it easy to maneuver.

4873-H

Calibrated Stopwatch Checks Sag

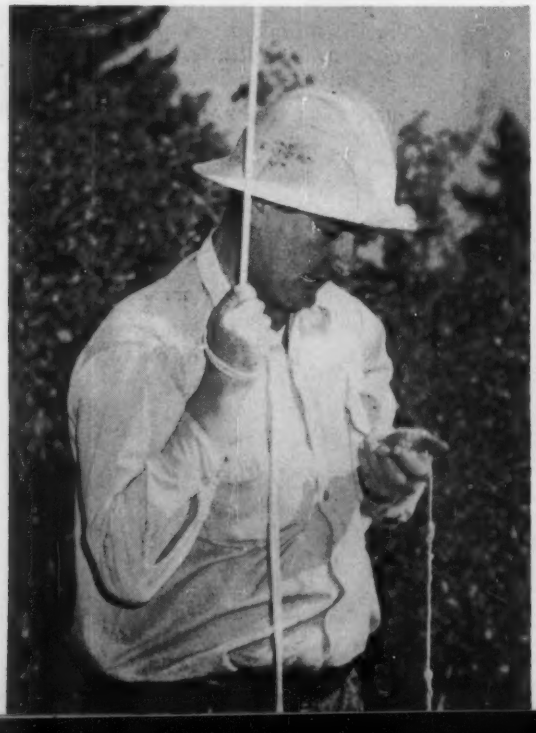
P. C. EVANS, *Project Supervisor, B. C. Engineering Co, Ltd, Vancouver, British Columbia*

Sags of medium and light conductors can be measured rapidly and economically to 1% accuracy by using a stopwatch, calibrated directly in feet of sag, to time the travel of a mechanical wave produced by striking the wire.

The principle of sagging by wave-timing has long been recognized. By eliminating setting and sighting targets, especially for vertical or delta configurations, it saves valuable manhours.

A mechanical wave, initiated by striking the wire a sharp blow near one support, travels to the far support, reflects, and passes back and forth repeatedly, though constantly attenuated. The impulse can be given by mallet or gloved hand and return waves felt or seen. Or it may be initiated by tugging a cord from the ground with the return felt through the taut cord.

A standard stopwatch can be used to time wave transit, and published tables convert time to sag.



But the author's sagwatch improves and speeds the method by reading sag directly in feet and inches corresponding to the time required for three complete wave transits. Eliminating use of tables speeds the operation and reduces chances for error.

The sag formula is

$$D = \frac{w L^2}{8 P}, \text{ where}$$

L = span length, ft
P = wire tension, lb
w = wire weight, lb per ft

The ratio $\frac{P}{w}$, however, is a direct function of the transverse wave velocity

$$v = \sqrt{\frac{Pg}{w}}, \qquad (2)$$

where $g = 32.2$ ft per sec^2

But time t, in sec, for the wave to travel one span is

$$t = \frac{L}{v} \qquad (3)$$

Combining (1), (2), and (3), we obtain the basic equation from which tables are calculated:

$$t = 0.49845 \sqrt{D} \qquad (4)$$

Precision is enhanced in direct ratio to the number of transits timed. Generally three round trips (six spans) will ensure 1% accuracy. Thus the sagwatch is calibrated for three returns,

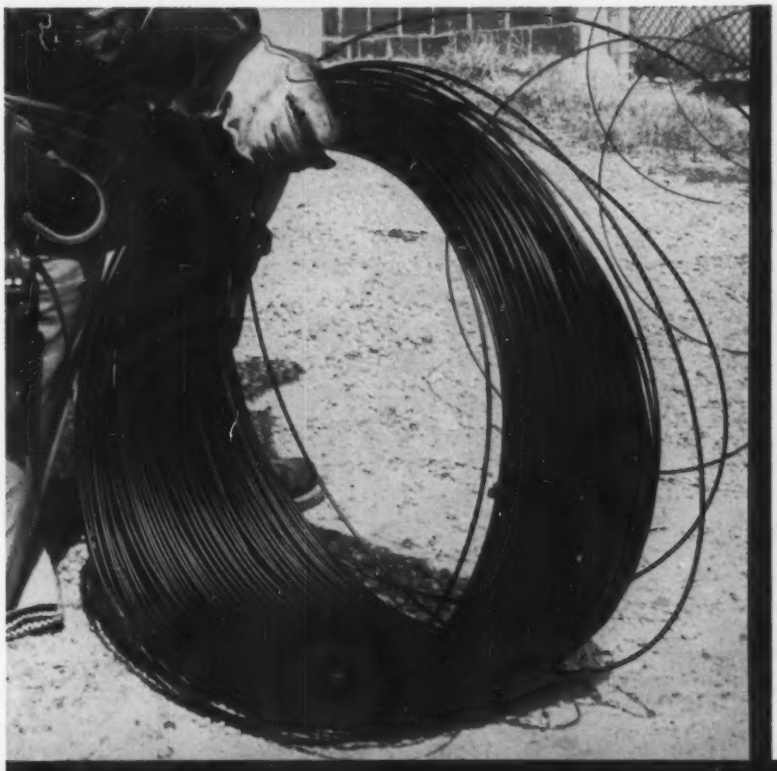
$$T_3 = 6t = 2.9907 \sqrt{D} \text{ sec}$$

Theoretically the method is good for any size conductor. But in practice it is usually limited to sizes not exceeding 250-MCM copper and 500-MCM ACSR. High attenuation and longer spans usually associated with larger sizes prevent adequate recognition of the third return wave.

Where more or less accuracy than 1% is desired, tables supplied with the sagwatch permit conversion for timing second or fifth returns.

With some practice, the operator learns to disregard minor harmonic vibrations. The designer recommends two or more separate readings for dependable results.

NOW
there's a new standard of toughness for plastic wire and cable insulation!



A new type of polyethylene plastic has been developed, which when used as cable insulation provides the excellent electrical properties of regular polyethylene, plus a toughness and abrasion resistance superior to almost any other plastic or rubber.

Hercules makes this new high density polyethylene, under the trade name Hi-fax, in a special grade designed for use in wire and cable. It is now available in tree wire, where a one-shot insulation of Hi-fax outperforms other types of heavy duty tree wire made with a protective sheath of nylon or varnish impregnated braid. Hi-fax serves equally well in service drop cable and insulated aerial cable, where outstanding abrasion resistance and mechanical cut-through resistance are needed.

Hi-fax cable can cut your installation and maintenance costs, and, at the same time, improve your power distribution system. Contact your present cable supplier for further information.

HOW HI-FAX COMPARES WITH OTHER INSULATIONS

	Hi-fax High Density Polyethylene	Conventional Polyethylene	Neoprene	PVC
Abrasion resistance	excellent	good	fair	good
Chemical resistance	excellent	very good	very good	very good
Cold bend	very good	very good	very good	fair
Corona resistance	fair	fair	poor	excellent
Dielectric strength	excellent	excellent	good	excellent
Environmental stress cracking	good	marginal	———	excellent
Flame resistance	poor	poor	very good	very good
Heat distortion temperature	good	poor	very good	good
Heat softening point	good	poor	very good	good
Insulation resistance	excellent	excellent	poor	good
Moisture resistance	excellent	excellent	fair	excellent
Oil resistance	excellent	good	excellent	good
Ozone resistance	very good	very good	good	excellent
Power factor	excellent	excellent	poor	poor
S I C	excellent	excellent	poor	fair

Hercules Powder Company does not manufacture insulated wire and cable, but supplies Hi-fax high density polyethylene in resin form to wire and cable producers.

Mail this coupon for a free copy of our new booklet

Cellulose Products Department
HERCULES POWDER COMPANY
900 Market Street
Wilmington 99, Delaware

Please send me a copy of your new folder, "Facts You Should Know About Polyethylene Wire Coatings."

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COMPANY_____

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CITY_____ STATE_____

CP58-5

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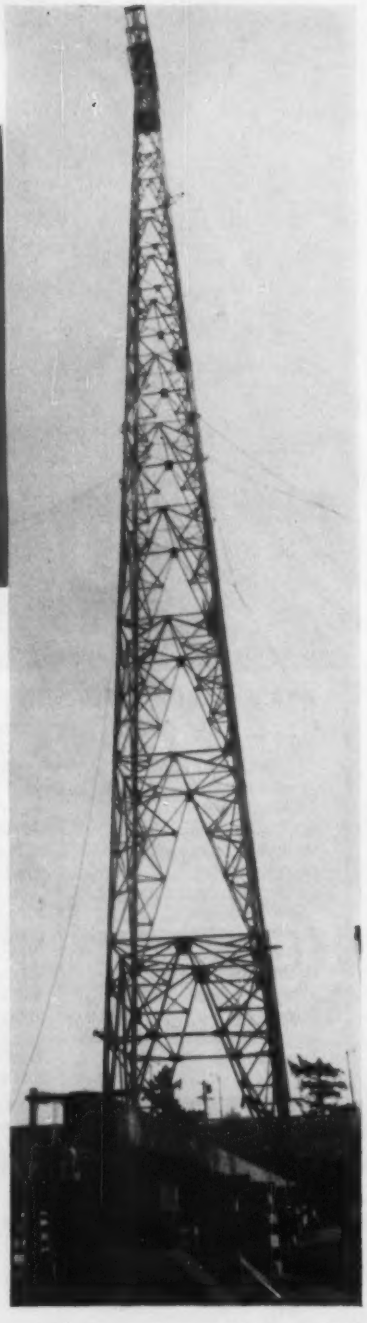
900 Market Street, Wilmington 99, Delaware

CONSTRUCTION



Transmission Towers Moved on Rollers Over Special Tracks

Two 246-ft-high transmission towers were moved 100 ft recently by Seattle City Light to make room for a new high-level bridge across the Lake Washington ship canal.

The towers, each weighing 45 tons, were raised off their foundations and moved on rollers over specially prepared cribbing trackways to their new locations. To enable the towers to travel over the rollers, the legs of each tower were connected with steel I-beams to which two 14x18-in. timber runners were fastened. While being moved, the towers were guyed four ways with steel cable.

The towers carry Skagit River power at 115 kv to the Broad Street substation and three 26-kv circuits as well. While the crossing was out of service, power was routed to other lines for about two weeks.

Two smaller anchor towers, each 105 ft high and weighing 19 tons, were moved in one piece by a mobile crane. A fifth tower, 180 ft high, was removed as it will not be needed in the relocated transmission line.

The tower-moving project was carried out by the Willar Construction Co on a low bid of $50,000.

(More Construction on page 86)

No. 11 in a series

Right off the Wire

Before the first nuclear-powered merchant vessel is launched, a new reactor system which has been designed is expected to reduce the cost of a comparable installation by forty per cent.

After leaving a new electric shaver plugged into an outlet overnight it can be used for a week without recharging.

A radio operator's vest, with pockets for dry cells, can be worn under outer garments in arctic cold. The batteries, when kept warm by body heat, are said to last ten times longer.

Automobile batteries are now made with cells which can be removed and replaced in a few minutes.

A new electronic surveying technique, now in use in highway layout work, enables engineers to establish numerous ground control points and measure distances in a matter of minutes. Maximum possible error is only 11 inches in 40 miles.

Copper strip is being made from powdered metal. The process can also be used for other metals which can be combined in no other way.

A portable building for use in the arctic has hollow walls of nylon fabric. When the walls are inflated the building stands erect.

A research program has begun for the study of new semiconductors for use in transistors. The materials are indium phosphate, gallium arsenide, aluminum antimonide.

An insulated guard rail for the end of the boom is made to protect a crane operator in case of contact with a power line.

More and better rayon is the object of a study of cellulose growth in living trees. Two-year-old pines are injected with radioactive carbon and are later cut down for examination.

A new plastic adhesive used in aircraft construction is semi-elastic and stronger than the metals it joins.

A new titanium alloy is made into sheets that will withstand air pressures of over 100 tons per square inch.

The "world's loudest noise" can be produced by a new compressed air loud speaker that is capable of projecting the human voice for ten miles.

Further information on these news items and on Simplex cable is available from any Simplex office. Please be specific in your requests.

Twelve pneumatic tires, each supporting a load of 20,000 pounds, enable a new lift to pick up and move concrete pipe sections at five miles per hour.

The Post Office Department has awarded a contract for the development of a mechanical letter-sorting machine.

Aerodynamic shapes designed to travel at over 8,000 miles per hour can be tested in a new wind tunnel.

Layers of steel, bronze and a mixture of lead and plastic compose a new dry bearing material that requires no lubrication.

Coils of aluminum, plastic or steel, up to 82″ O.D., can now be spiral wrapped by machine.

A new method of producing electricity uses a fuel cell that converts hydrogen and oxygen into direct current by means of a catalyst.

A new recording instrument measures heat absorption in any area and is used for allocating air conditioning or heating charges to tenants.

Quartz tubing is being made so small that fifty feet contain only one drop of water.

A new heat resistant paper is made of ceramic fibers.

Simplex Goes To Sea

The 36,000-foot "sea section" of the Simplex submarine communication cable, for use between Cape Neddick, Maine, and Boone Island Light, was loaded in August at Boston.

The cable came off a giant reel (dia. of head 126 inches) and was carried over a capstan to the 126-foot barge.

The cable is described as "4-conductor, No. 9 AWG stranded, ANHYDREX insulated, armored submarine communication cable."

The reel and its load of more than six miles of cable weighed 68 tons.

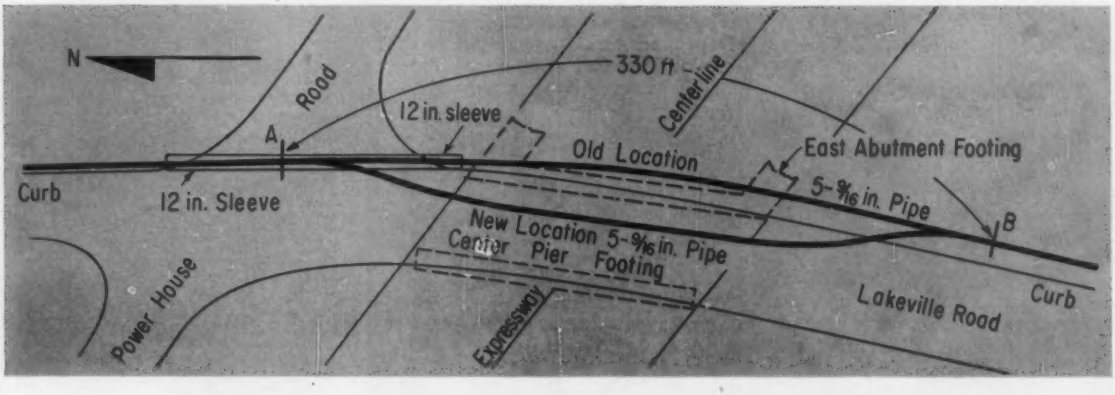
SIMPLEX WIRE & CABLE CO.
Cambridge, Massachusetts and
Newington, New Hampshire

Simplex

Highest quality cables for: Mining
Power & Lighting • Construction
Transportation • Communications
Signalling

Cable Rig Aids 230-kv Stringing

A tension stringing rig of 5,000 lb capacity, capable of handling large conductors up to 1,000,000 cir mil at 2-3 mph has been acquired by Niagara Mohawk Power Corp. Designed to keep ACSR conductors in the air and under tension during stringing operations and to protect against damage, the rig has separate reel trailer and tension rig that can be nested together or used separately on different projects. It is pictured in use on 230-kv line in eastern New York State.



Winch Relocates Pipe Type Cable

F. W. KLINE, Superintendent of Construction,

F. J. WELLS, Senior Engineer, Long Island Lighting Co, Hicksville, N. Y.

Long Island Lighting Co recently relocated about 330 ft of 69-kv pipe type cable without removing and reinstalling the cable. The circuit was de-energized for less than 6 hr.

Because the location of the 5-9/16-in. somastic coated piping conflicted with a proposed expressway tower footing, it was necessary to move the cable 23 ft. Normally, this would require removal and reinstallation of the cable. However, further studies indicated that the cable's existing curvature would permit its relocation intact.

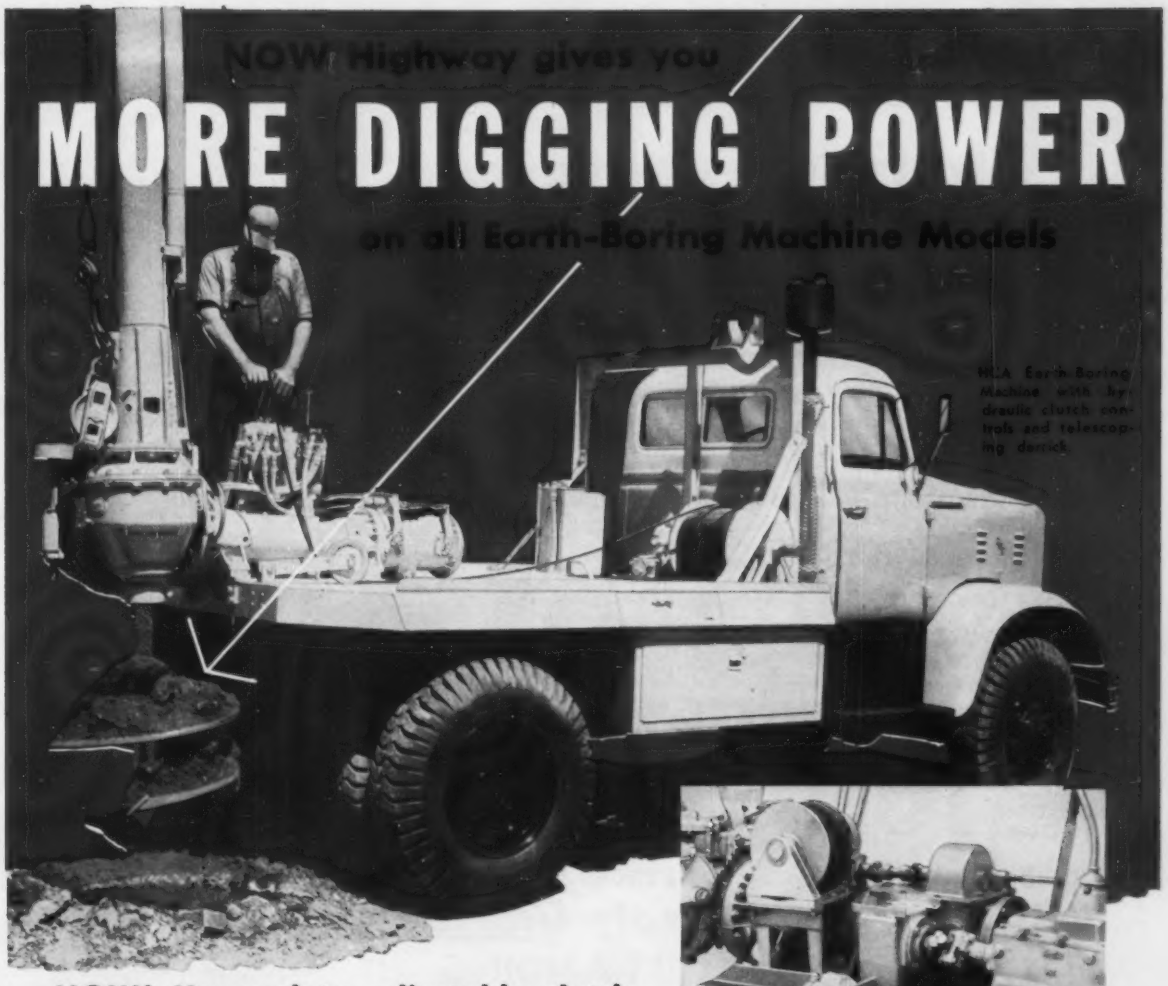
An excavation was made to the depth of the cable pipe and wide enough to include the existing and proposed pipe routes. Planks were inserted under the cable pipe. The pipe was then slowly slid on the planks to the new position by means of a sling and cable powered by a winch truck. The relocation was accomplished in about 35 min. The somastic coating of the cable pipe was then tested for intactness and found satisfactory.

(More Construction on page 88)

NOW Highway gives you

MORE DIGGING POWER

on all Earth-Boring Machine Models

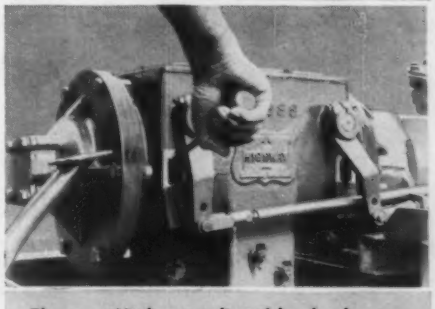


HCA Earth-Boring Machine with hydraulic clutch controls and telescoping derrick

NOW! Heavy-duty adjustable clutch and integral winch on all skid-mounted and truck-mounted diggers

Now Highway gives additional digging power on all its earth-boring machine models for fast, easy digging in any soil. The HDA and HCA models derive their power from the truck engine and permit holes to be dug in all truck transmission speeds. Mount on any vehicle with sufficient capacity to handle the weight and operate the machine. Highway earth-boring machines are available in sizes to dig holes up to 36" in diameter and to an average depth of ten feet. Available with manual or hydraulic clutch controls. Find out how Highway's earth-boring machines can save you time and money. See your Highway representative now — or write directly to Highway Trailer Company for illustrated brochure.

Integral Winch takes power directly from the transmission and allows all speeds of transmission to be used.



The new Highway adjustable clutch provides more speed and more power. Easy field adjustment saves you costly down-time and shop maintenance. Stronger shift shafts give more pressure on the clutch with less control pressure.

UTILITY DIVISION

HIGHWAY TRAILER COMPANY

HEADQUARTERS: EDGERTON, WISCONSIN

Manufacturers of: Public Utility Bodies • Earth-Boring Machines • Pole and Cable Reel Trailers • Winches • Power Take-Offs • Service Accessories • Commercial Trailers • Trailerized Tanks and Dry-Bulk Haulers • Cargo Containers — Land, Sea and Air

SALES AND SERVICE IN PRINCIPAL CITIES

HIGHWAY

BODENDIECK'S NEW

fiberglas shotgun

Permanently sealed TUBULAR FIBERGLAS construction with external FIBERGLAS control rod providing:

- **LIGHT WEIGHT—8 ft. model weighs 5½ lbs.**
- **HIGH DIELECTRIC—100 KV ea. ft. 5 min. test.**
- **LOW MOISTURE ABSORPTION—Not affected by surface scratches.**
- **LOW UPKEEP—No refinishing required**
- **LONG SAFE LIFE—Components non-deteriorating.**

NOW AVAILABLE: 4 ft., 6 ft., 8 ft. and 10 ft. lengths.

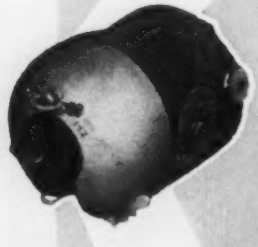
▶ **Your inquiries covering this and other quality BODENDIECK products are invited. Prices and specifications promptly sent on request.**

BODENDIECK TOOL CO.

TAYLORVILLE, ILLINOIS

THE BEST WAY TO INSTALL CABLE

"is to spin it"



For Information Write, Wire or Phone

CABLE SPINNING EQUIPMENT CO.

3100 Topeka Ave. Topeka, Kans.

FOR RUGGED DEPENDABILITY

Specify **Grip-Tite** EXPANDING EARTH ANCHORS

Exclusive Grip-Tite *wing* dimples, plus deeply embossed base plate, distributes stress evenly resulting in greater holding power. *Four-Way Design* places a greater portion of expanding area into undisturbed soil and yields more holding power in average soils.

Come To Us With Your Anchoring Problems

Grip-Tite anchors come with *nut retainer*. Prevents anchor from sliding up the rod during installation. Permits salvage, too.

Exclusive double-strength anchor top prevents damage from expanding tool during installation.

DEPENDABILITY AT LOW COST

STEEL EXPANDING **Grip-Tite** ANCHORS

Grip-Tite MANUFACTURING CO.

BOX 111 WINTERSET, IOWA

Special Bucket Digs Tower Grillage Pits

A new type of excavator for tower foundation grillages has been developed by Duke Power Co. Attached to a 6-ton truck mounted crane, the excavator consists of a modified ⅜ cu yd clam shell bucket attached to leads made from 4-in. pipe.

The machine was used for digging grillage pits on 36 miles of double circuit 230-kv line. The excavator was able to dig holes of any desired dimension above a minimum of 2 x 5 ft to a maximum depth of 12 ft. Most of the holes were 4 x 5 x 10 ft. Digging time in clay soil for this size hole was 9 min. It was used to excellent advantage for cleaning out rock after blasting for transmission line construction.

Operation of the excavator is the same as for a regular clam shell except that provisions were made for applying down pressure during the bucket closing cycle. To assure positive digging action, a special brake was incorporated into the design. It consists of a cable stretched from the clam shell to the top of the pipe leads and looped around a drum attached to the end of the boom. By braking the drum, the clam shell is prevented from rising as it bites into the dirt.

(More Construction on page 91)

public utility men prefer—

YORK-HOOVER
YMR-76 Service Bodies

MODERN

PROVEN

EFFICIENT

"Custom" features such as material drawers with adjustable compartments are available as standard or optional equipment, as required.

LESS SERVICE HOURS . . .

plus extra savings in operators time are the results obtained by hundreds of YMR-76 Service Bodies in operation today. That's because YMR-76 units are compact and rugged . . . provide ample and convenient carrying space for materials and tools . . . with capacity for adjustment to meet changing conditions. Write for complete details, price and delivery information today!

CLIP AND MAIL TODAY!

Dept. 1E, York-Hoover Corporation
York, Penna.

Please send me a copy of Bulletin No. 942 covering your YMR-76 Service Body.

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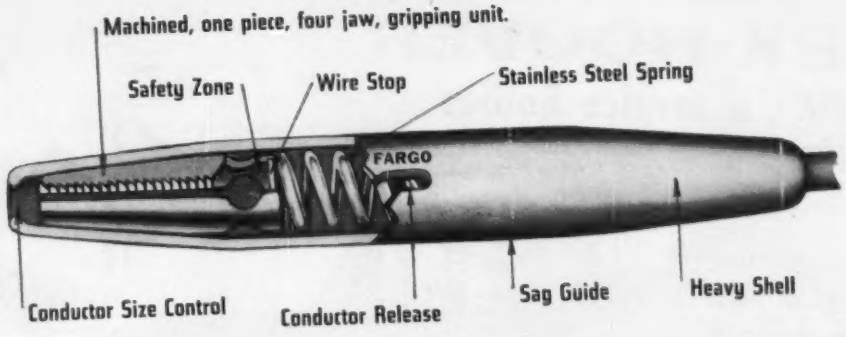
Address_____

City and State_____

BODY DIVISION
YORK-HOOVER CORPORATION
YORK, PENNSYLVANIA

CREATIVE ENGINEERING FOR THE PUBLIC UTILITY INDUSTRY SINCE 1892

The inside story...



ALUMINUM OR COPPER

Fargo Line Splices

Quick as a wink you've automatically . . . without tools made a permanent connection with a Fargo Line Splice and saved time and money in the bargain. Inside the tough copper (or aluminum) shell is a foolproof, precision-engineered, gripping jaw that works right every time. It's the inside story that counts . . .

The famous Fargo one-piece jaw with four segments assures perfect alignment for a sure grip on the conductor. Mechanically, it can't be beat, and electrically, the splice including contact resistance, has greater conductivity than an equal length of conductor.

Fargo "Automatic" Line Splices are available in a wide choice of types and materials. There are types available for aluminum or copper conductors, reducing splices, insulated splices, messenger splices . . . dead ends too.

You'll save time, money and headaches on new construction, and emergencies, with Fargo Automatic Line Splices.

"Automatic" Messenger Splices

"Automatic" Reducing Splices

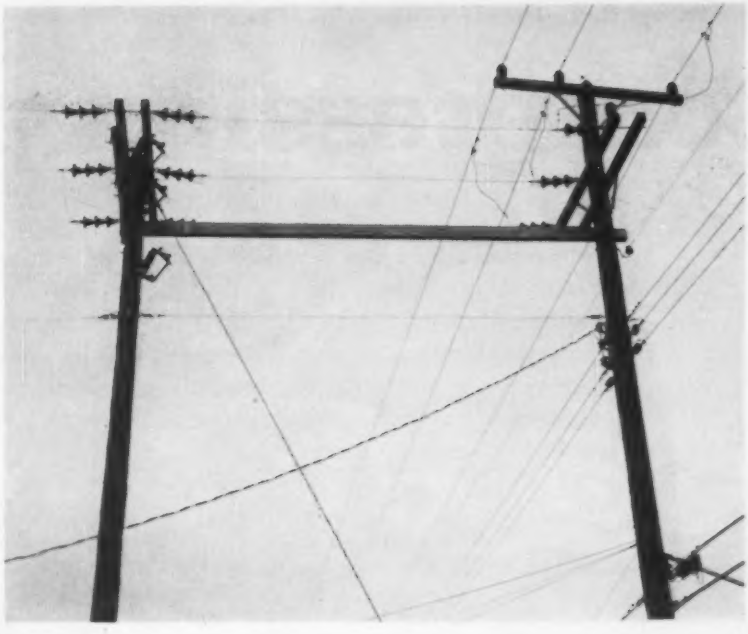
"Automatic" Insulated Splices

Distributed by
LINE MATERIAL INDUSTRIES
McGraw-Edison Company
Milwaukee, Wisconsin
In Canada, CANADIAN LINE MATERIALS, LTD., Toronto, Canada

Manufactured by
FARGO MFG. COMPANY, INC.
Poughkeepsie
New York

FARGO

Solve Slack Span Problems



Trouble with 12-kv slack spans in the Gulf Coast's salt atmosphere has been reduced appreciably by Central Power & Light Co engineers by use of a timber between poles of the slack span. These slack spans are 20 to 30 ft long with the first pole away from the junction pole guyed.

Tap lines are taken off the junction poles on buck arms. To put arms for the tap line on the same level, the first pole away from the junction pole is set two or three feet deeper.

With the slack in the span there was trouble with conductor burn downs and with radio and television interference due to lack of tension on strain insulator hardware. Even when conductors were pulled up enough there was just enough give in the junction pole so that the top moved and put slack in the span.

To solve the problem, 4 in. by 6 in. timbers are installed between the two poles. With this arrangement more tension can be put on conductors in the slack span and relationship of the pole tops is maintained so that wires do not slack off. This prevents the burn downs that were experienced before and eliminates TV and radio interference problems.

For these jobs, 20 or 22 ft timbers are normally required. However, timbers as much as 30 ft long are sometimes used.

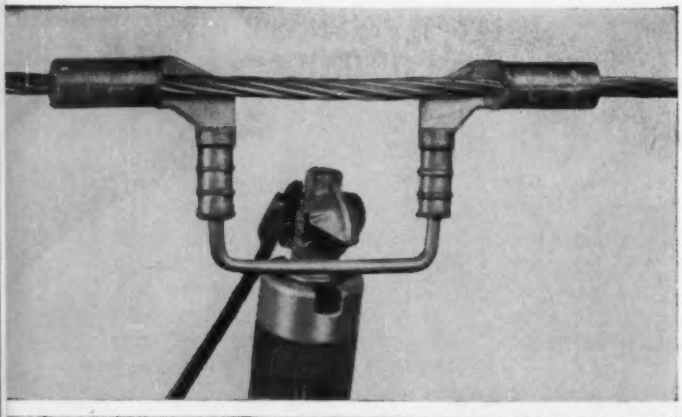
When there are no sectionalizing cutouts on the tap, strain insulators are installed only on the junction pole. When fused cutouts are installed on the tap they are placed on the first pole away from the junction pole. This complicates the slack span problem because of the tendency to increase the slack and because there is more chance of radio and TV interference with more slack strings of strain insulators. This problem too is solved, however, with the timber between the poles.

Trailer Handles Transformers

First job for a new 300-ton capacity trailer was the moving of a 200-Mva, 230/115/13.2-kv 178-ton transformer for Niagara Mohawk Power Corp. The 33-wheel trailer "hangs" transformers in a cradle supported by two 69-ft box girders 4 ft deep and 2 ft wide. The cradle can be moved front or back to equalize tire loading. The 120-ft trailer is powered by two tractors. Their drivers and foremen on foot keep in touch by phone. ◀

Kearney's compression program

Added versatility and increased application with existing tools—that's what an investment in Kearney Compression can mean for your system. Besides the basic connections—Squeezons, Serv-En Service Entrance Sleeves, Tension Sleeves and others—you receive the advantages of ever widening tool flexibility as Kearney Engineers continue to develop and introduce new Compression Fittings to the field.

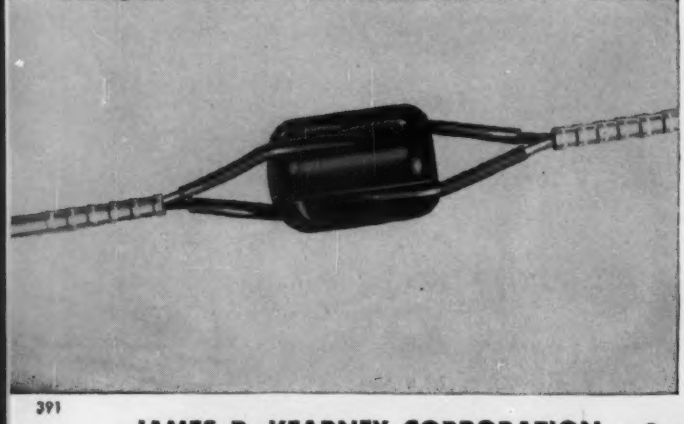


KEARNEY L Squeezon Stirrup

Line side connections are outside the basket—sufficient clearance for either the hydraulic or mechanical tool. The three inch dimension between the line and stirrup makes the unit neat and compact—hot line clamps are readily installed. Unit may be completely covered with line guards.

KEARNEY Compression Terminal

Kearney Compression Terminals provide an efficient method of connecting aluminum conductors to terminal pads. Flaring of strands possible with conventional terminal pads is eliminated. The strands are retained in an aluminum sleeve. Terminals have NEMA 1¾" bolt centers. May also be used as disconnectable jumpers around double dead-ends. The sleeves are filled with Kearnalex Contact Aid and capped and will take conductor sizes from 1/0 to 397.5 MCM 18/1 ACSR.



KEARNEY Insulated Splice

The Insulated Splice was designed primarily for splitting secondaries into shorter sections where additional transformers have been installed and for series street lighting applications. No changes in existing construction are required. Designed for copper, aluminum and ACSR connections, this splice features one piece construction, tension-type sleeves, insulated stainless steel bails and a high strength strain insulator. Splice can be installed with Kearney Hydraulic or Mechanical Tools. ACSR and aluminum sleeves are packed with Kearnalex Contact Aid and plastic capped.

JAMES R. KEARNEY CORPORATION • General Offices: 4224-42 Clayton Ave., St. Louis 10, Mo.

pays extra dividends

KEARNEY INSIDE TAPERED COPPER SLEEVE

A completely new, cost-cutting design—another Kearney "dividend"—permanent, positive, full tension splicing of energized conductors with standard Kearney tools and dies.

ADVANTAGES—

1. **Metallizing process**—copper sleeve is sprayed internally with conductive metal to assure maximum holding power and high conductivity.
2. **Full Inside Taper**—design assures ease of insertion of hot conductors—also relieves stress, due to vibration, at the extremities of the sleeve.
3. **Shorter Length** means less installation time, fewer crimps and no sacrifice of holding power—sleeve is more easily stored.
4. **Clearly marked** with conductor and die sizes.

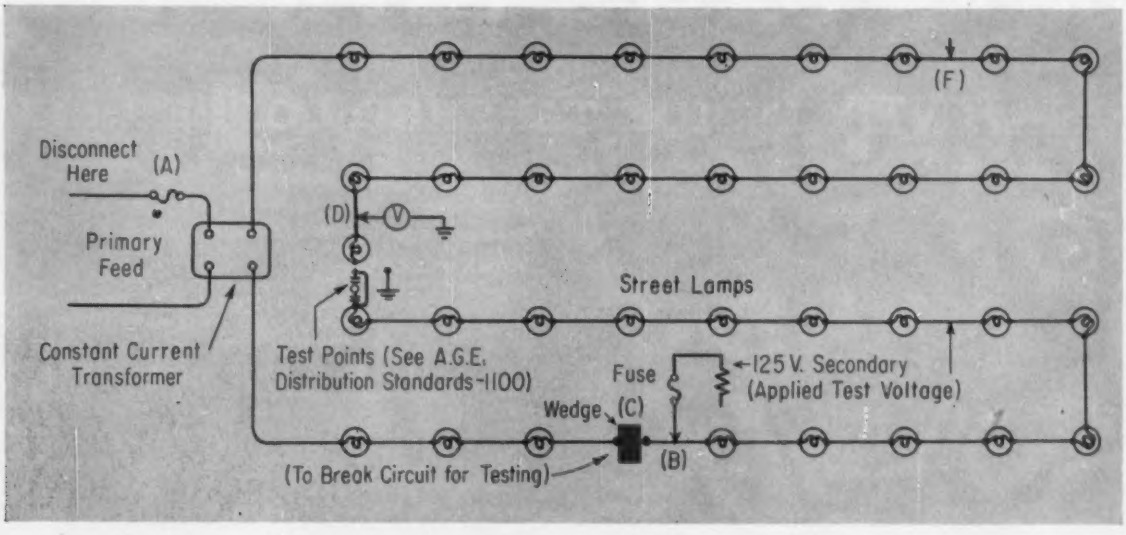
KEARNEY WH-1 TOOL

A rugged, reliable hydraulic tool which expedites the installation of Kearney compression fittings and sleeves. Hi-speed, two-valve pump permits fewer strokes for full compression—exerts 21,000 pounds thrust. The narrow "C" head permits full visibility of the working area. Balanced weight enables the lineman to position the tool quickly and accurately for each indent. Interchangeable, insulated wood handles with extra length are available for working higher voltages.

FOR BETTER CONSTRUCTION—SAFER MAINTENANCE

Specify Kearney Products

PLANTS AT: ST. LOUIS • FAYETTEVILLE, ARKANSAS • SHENANDOAH & CLARINDA, IOWA • GUELPH, ONTARIO, CANADA



Spectrometer, Helium Spot Cable Leaks

JEROME J. COLLINS, *Assistant General Superintendent, Outside Plant Construction Department*

ROBERT W. GILLETTE, *Senior Engineer, Electrical Engineering Department, Consolidated Edison Co of New York, Inc., New York, N. Y.*

Use of a mass spectrometer, designed for detecting leaks in low-pressure, gas-filled cable, has been extended by Consolidated Edison to the detection of leaks in pipes and pressure vessels.

This instrument is sensitive to traces of helium in a mixture of gases. When a gas is drawn into it for testing, a gauge reading and an audible signal give notice of the presence of helium in the gas in amounts greater than one part in 300,000. Accordingly, helium can be used as a tracer gas in the investigation of leaks in cable pipes and pressure vessels. Helium is used as the tracer gas because the amount of it in the atmosphere is insignificant, and the gas is not harmful to cables.

For field use, the mass spectrometer is mounted in a panel-body truck and held in position between foam rubber shock-proof mounts which protect it from external vibration.

The instrument is kept under vacuum at all times to eliminate pump-down time when it is used for testing. For the same reason, it is kept in operation from a power outlet in the garage when it is not being used in the field.

Detection of leaks in gas-filled cable has always been a long and methodical process of elimination. Loss of gas on the system is indicated by a low-pressure alarm, or by the amount of nitrogen required to maintain pressure on the feeders. Once known, the loss of gas is reported to the company's maintenance personnel, who start an investigation.

When the location of a leak is to be determined by this method, helium is introduced into the leaking feeder. A mixture of 10% helium and 90% nitrogen is commercially available in 220-cu-ft cylinders, and this mixture may be admitted to the cable system through a fitting on a cable in a manhole or some other convenient point, the normal supply of nitrogen to the feeder having been closed off. Depending on the size of the leak and the length of the feeder run, enough time is allowed for dispersion of the tracer gas through the feeder and its passage through the leak.

In normal practice the cylinder of tracer gas is connected to the feeder on the day preceeding the planned leak-locating work.

The cable route is then patrolled and the atmosphere in the cable manholes is sampled to detect the presence of helium. The sampling is done by inserting a probe or sniffing tube through a ventilating hole into the manhole cover. This inspection fixes the general locality of the leak.

The simplicity and economy of

Save Time Locating Street Lighting Circuit Breaks

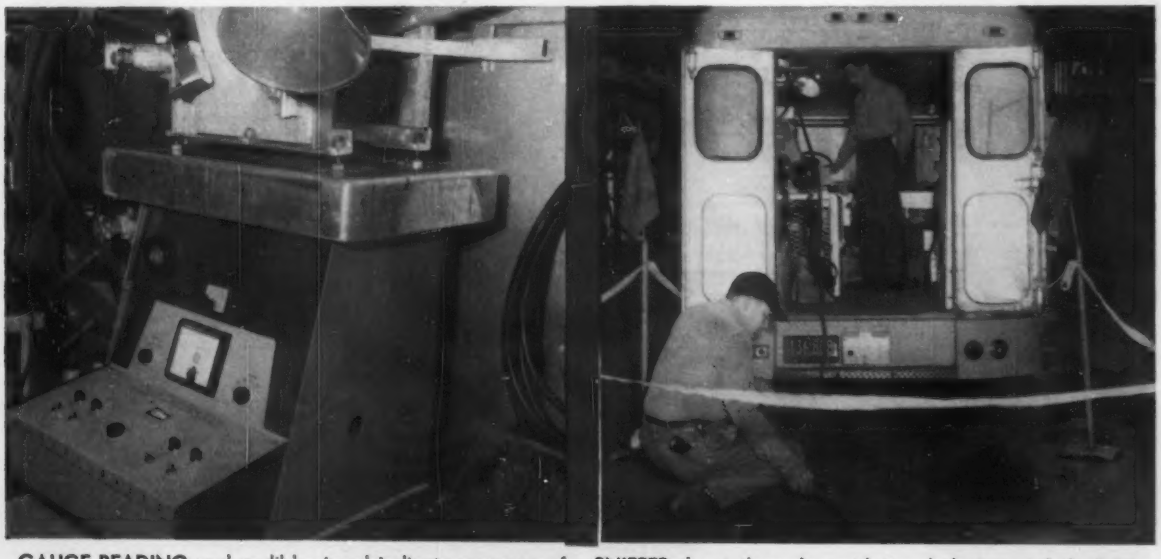
G. H. BROYLES, *District Service Foreman, Appalachian Power Co, Roanoke, Va.*

Locating opens in street lighting circuits by applying a voltage and tracing continuity with a voltmeter gives more positive results and saves time for Appalachian Power Co.

The circuit is checked for contact with primary lines. After the primary feed to the constant-current transformer is disconnected, the circuit is grounded through a small fuse to make certain that the circuit is not energized. This fused ground is used only as a test, and it should be removed before the 125-v secondary is connected.

A low-voltage secondary (125 v) is connected at a convenient point through a 15-amp fuse. The nearest street lamp is removed and a wooden wedge is inserted into the bayonet socket to hold the circuit open. Voltage readings to ground are made at various points on the line. A voltage reading means that the circuit is continuous to the point checked. The fault is located by splitting the remaining circuit into halves and then repeating the voltage test.

Formerly, a ringing magneto was used to test continuity. False readings often occurred because parallel primary lines induced a voltage which caused the bell to ring.



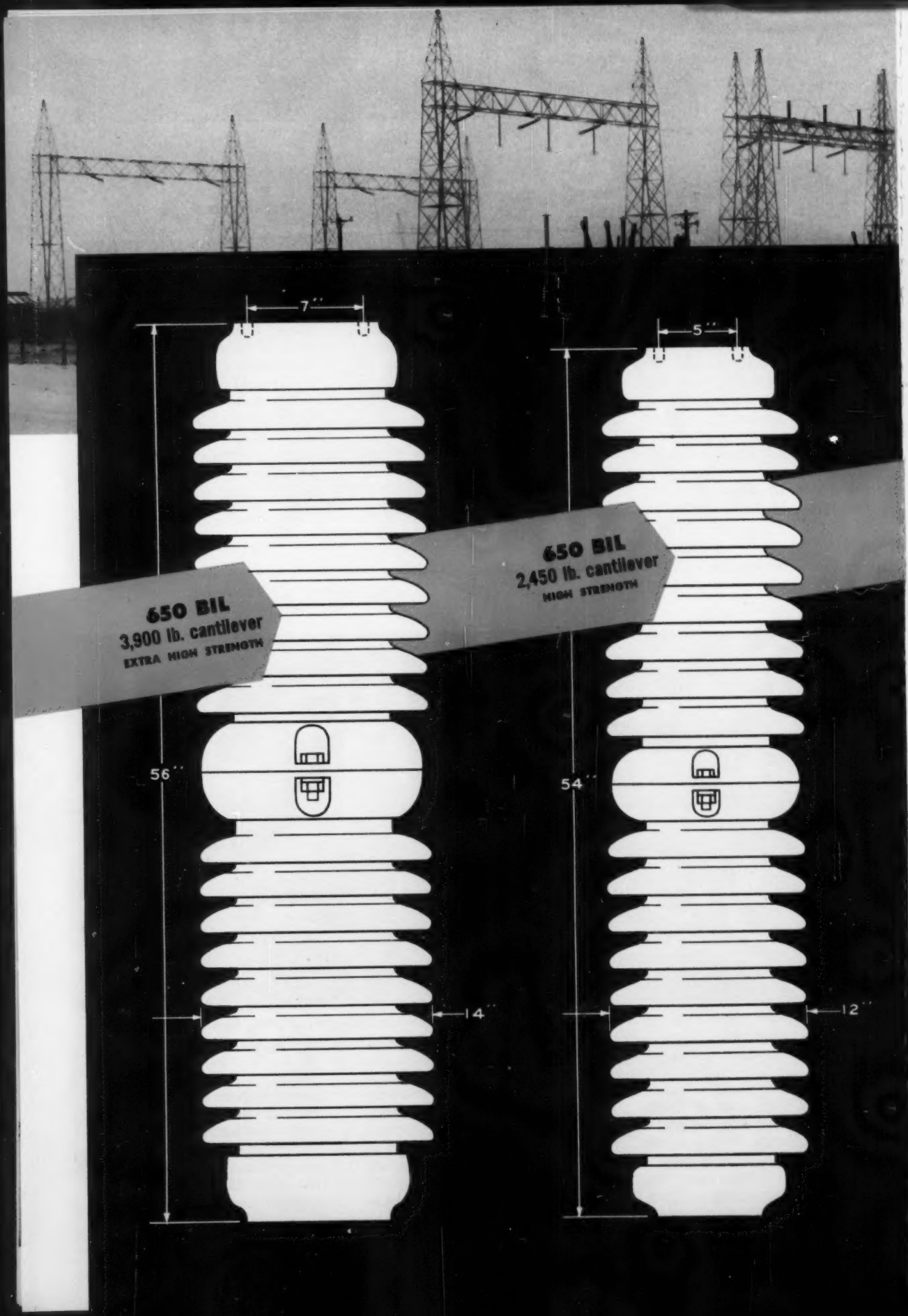
GAUGE READING and audible signal indicate presence of helium in locating leaks in low-pressure, gas-filled cable

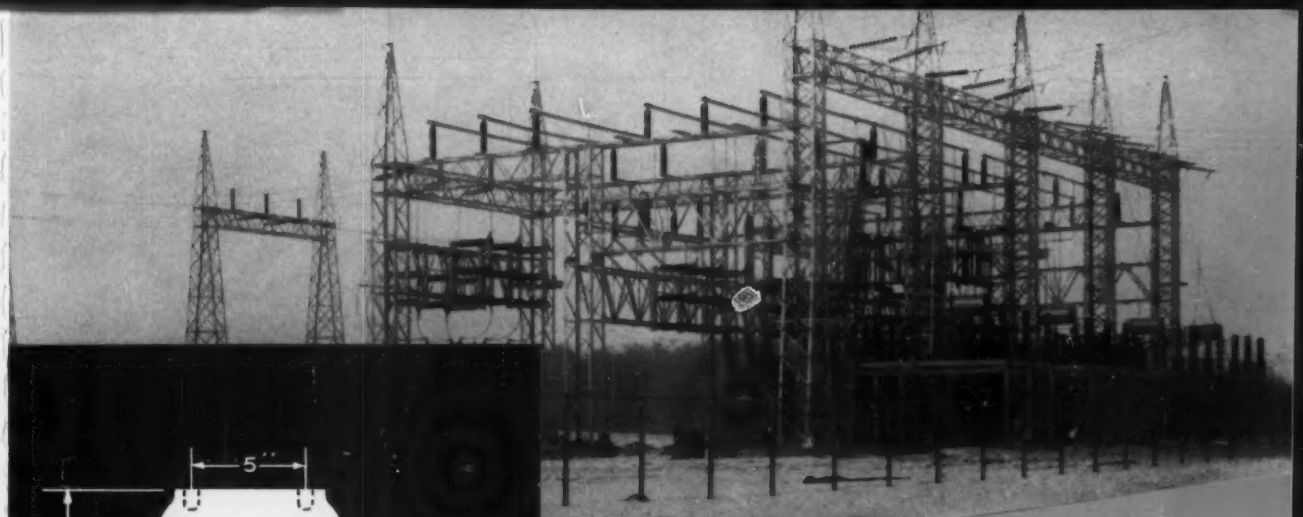
SNIFFER thrust through ventilating hole in manhole lid is attached to spectrometer mounted in the field truck

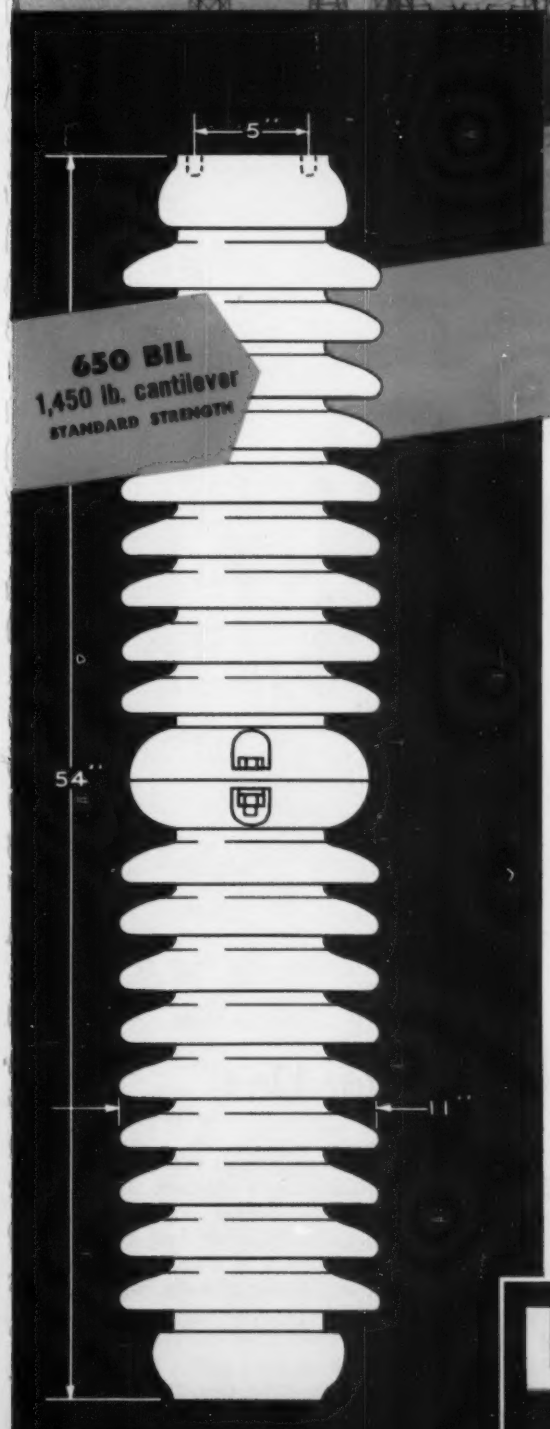
this method of leak detection is apparent when contrasted with the location of such leaks through the establishment of a pressure gradient along the feeder route.

The older method often required the establishment of temporary stop joints, involving feeder outages, for positive identification of the defective cable section. The procedure consisted of many steps and required opening many manholes.

In the identification and location of leaks on buried pipe lines, bar holes are driven through the earth near welds or other joints, and the atmosphere in these holes is tested for helium after the pipe has been filled with a helium-nitrogen mixture. ◀


650 BIL
3,900 lb. cantilever
EXTRA HIGH STRENGTH
650 BIL
2,450 lb. cantilever
HIGH STRENGTH
7"
5"
56"
54"
14"
12"





650 BIL

LAPP STATION POSTS

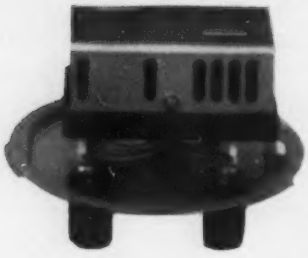
the station insulators specifically designed for 138 kv service

Use of Lapp Station Posts rated at 650 BIL gives designers of 138 kv systems their first chance for most efficient balance of structure cost and electrical characteristics. As compared with use of 161 kv station insulators (until now the only "safe" construction for 138 kv) these new units provide greater strength and rigidity with less weight . . . permit more flexible, more compact station design, with smaller air break switches . . . are suited to horizontal mounting . . . allow wider spacing of bus supports under short circuit forces . . . all at lower costs for insulators *and* structure.

For best performance, highest reliability, lowest cost, design 138 kv stations on Lapp 650 BIL Station Posts.

Lapp Insulator Co., Inc., Le Roy, New York.

Lapp



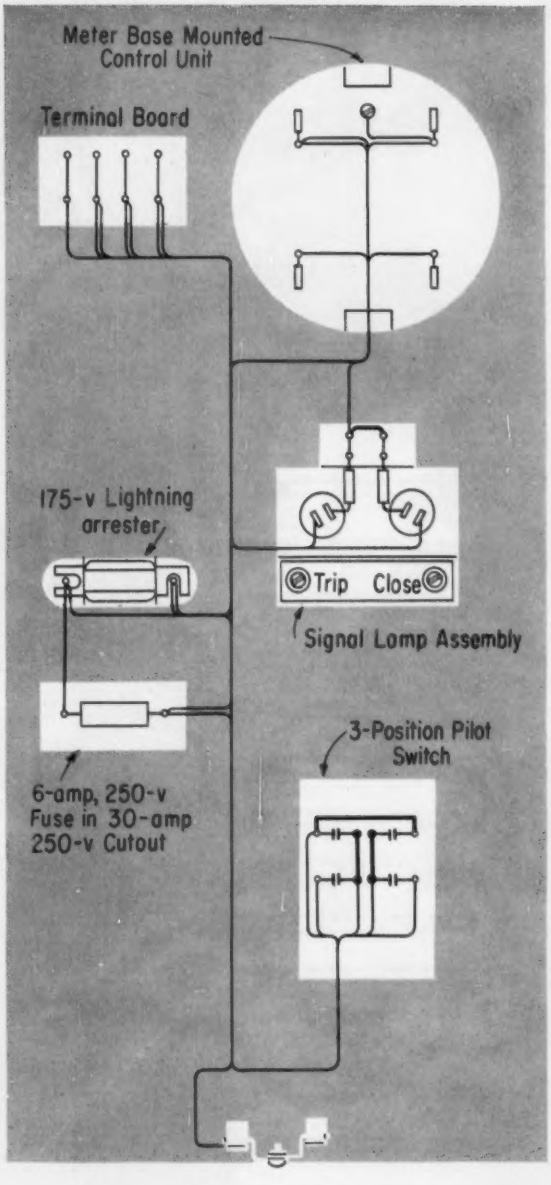
Switch Controls Capacitors Thermally

H. CLARK DENISON, Planning Engineer, Oklahoma Gas & Electric Co, Oklahoma City, Okla.

An increase in temperature sensitive reactive loads has resulted in plans by Oklahoma Gas & Electric Co to install one thermally-controlled switched capacitor bank on each feeder having this type of load. The step will be gradual. No new time clocks will be purchased until the temperature-controlled installations have been completed. The first switched capacitor bank will be time controlled, but subsequent installations on the feeder will be thermally controlled. The thermostatic controls are interchangeable with time clock controls.

Thermal controls for capacitor banks are set to turn on at 90F and off at 88F. The temperature difference prevents hunting.

The thermostat, mounted on a standard meter base with a glass cover, is installed in a cabinet. Build-up of radiant heat in the cabinet is prevented by the use of insulating paints and vents. Enclosure of the thermostat in the glass meter cover simulates conditions in the home. Retarding of temperature rise and fall within the thermostat enclosure, together with chosen off and on settings, makes the control follow the use of air conditioning in the home very closely.



Carrier Current Controls Diesel Generator Unit

HENRY A. SMITH, Engineer, Station Electrical Engineering Dept, Commonwealth Edison Co, Chicago, Ill.

Frequency shift carrier is used by Commonwealth Edison Co to control a remote diesel generator. Unnecessary starting is avoided, and operation is limited to minimum requirements.

Loading of the 12-kv feeder at the distribution center supplying the area fed by the generator is the basis for control. The feeder is 14 miles long, has a connected lead of seven 12/4-kv autotransformers, and has 900 kvar of shunt capacitors. Fused ties to other feeders total 60 miles.

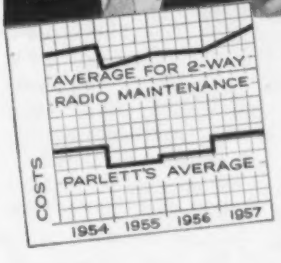
The carrier control has performed reliably at a frequency of 100 kc despite the high attenuation of the channel. A low voltage start—low reactive output shutdown system is used to control the unit in case of low voltage due to system trouble because of outages.

(More Operation & Test on page 100)

RCA RADIO . . . FIRST CHOICE OF THE LEADERS

"4-Year Maintenance Study Proves the High Reliability of our RCA Radio"

—Says **C. J. McAllister,** *Vice-President and General Manager*
The Parlett Gas Co., Waldorf, Maryland



"A 4-year maintenance study proves the high reliability of our RCA Radio as seen in above chart. Records show that maintenance costs for our RCA Radio system were less than half of those experienced by many other radio users."
—C. J. McALLISTER
THE PARLETT GAS CO.

"Records over a 4-year period show that our maintenance costs were less than half of those experienced by many other radio users. Good service is very important in our business and RCA 2-Way Radio has helped us in many ways to provide the best service obtainable, by staying on the job."

With RCA Radio, this progressive company blankets a 30-mile radius from each of its plants. Top quality performance is the result of the quality components that make up their RCA system. If you're thinking of radio for your business you'll be interested in these advanced RCA features, including: the transistorized "Red Head" Microphone to transmit clear speech and fit the hand perfectly; "Split Channel" readiness; "Minitrol" base station equipment that combines microphone, controls and speaker in a single unit. Purchase, lease, or time payment agreements available. RCA service available for reliable maintenance.

Just mail the coupon below for valuable information about the use of RCA 2-Way Radio and how it can quickly pay for itself out of increased calls and profits.

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COMMUNICATIONS PRODUCTS
CAMDEN, N. J.

Radio Corporation of America
Communications Products
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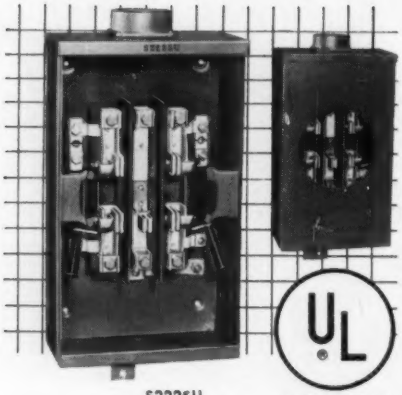
In Canada: RCA VICTOR Company Limited, Montreal

☐ Please send me a copy of the complete record of RCA 2-Way Radio in use at The Parlett Gas Co.

NAME _____ (PLEASE PRINT) TITLE _____
COMPANY _____
ADDRESS _____
CITY _____ ZONE _____ STATE _____

☐ Have representative call.



S222SU

The Milbank

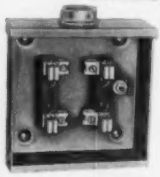
200 Amp Socket

with levers for positive clamping

APPROVED

The rain-tight Milbank sockets illustrated here bear Underwriters Laboratory approval for use with ***either copper or aluminum wire.*** The new 200 amp socket is offered with or without by pass, featuring all front adjustments with no side clearances required.

S111BRC1



Ask about the Milbank line ranging from the 100-amp midget to the 200-amp high capacity.

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MANUFACTURED IN ACCORDANCE WITH, OR FOR USE UNDER U.S. PATENT #2,735,979

Reduce "set-up" time for relay testing to minutes with portable . . .

Multi-Amp V3DC-3PH. Multi-Amp eliminates sprawling test apparatus, confines instrumentation to a single enclosure for quick, efficient single or three-phase testing of relays. Test unit is a continuously adjustable current or voltage source. Tests may be made under single or three-phase conditions. Complete metering and timing instruments to monitor output.

Multi-Amp insures continuous power for continuous production. Saves man-hours, eliminates involved circuitry, speeds "set-up" time. Features complete portability, ease of use, safety. Standard models from 0.1 to 100 KVA for most applications; custom-engineered units as required.

Send for detailed literature.

MULTI-AMP® CORPORATION
465 LEHIGH AVENUE • UNION, NEW JERSEY

Impulse Generator Tests Apparatus

L. LISHCHYNA, Engineer, Hydro-Electric Power Commission of Ontario, Toronto, Ontario, Canada

A highly accurate, portable one-stage 20-kv surge generator has significantly extended Ontario Hydro's impulse-testing facilities. More accurate than high-voltage impulse generators in the lower voltage range, the 20-kv generator is compact enough to be operated by one man.

The surge generator is housed in two rectangular bakelite boxes each having a transparent lucite top and equipped with two metal carrying handles. In both depth and height each box is slightly less than 1 ft. One box is 18 in. long, the other 24 in.

One box contains a high-voltage dc source, and the other a pulse-forming circuit and a tap-control circuit. The two boxes are interconnected with a 3-conductor jumper cord. Two conductors of the cord carry the 115-v ac supply from one box to the other. The third conductor, by providing an electric connection between the two boxes, completes a safety circuit which permits the generator to be used only with both covers closed.

The specimen to be impulse-tested is connected to the high-voltage bushing mounted on the side of the box housing the pulse-forming circuit. On the front panel of the same box are mounted two coaxial fittings through which an attenuated test wave and synchronizing pulse are applied to an oscilloscope for display of the generated wave.

The 20-kv impulse generator is used only for impulse tests on low-voltage electrical apparatus such as service entrance breakers and watthour meters. Tests are either acceptance, development and design improvement, or specifications development and revision tests.

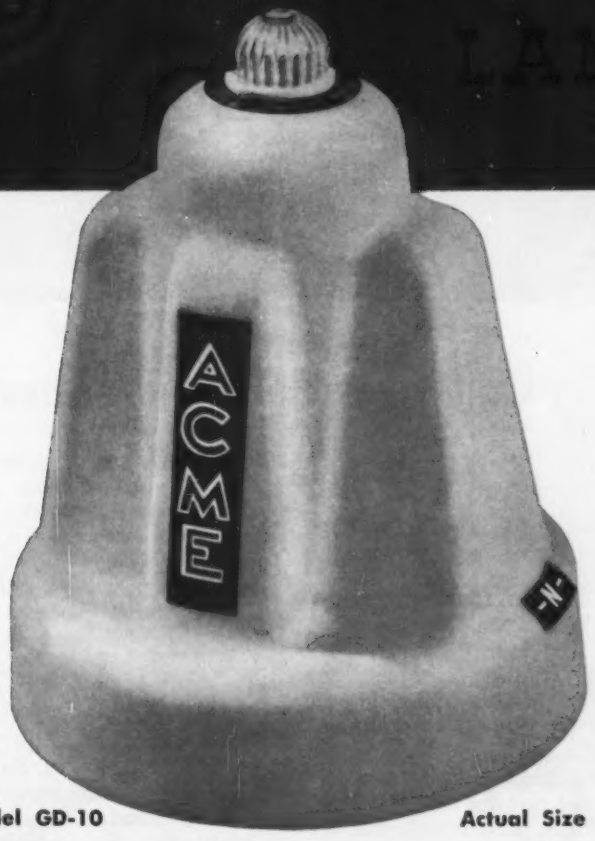
Performance of the 20-kv generator has been satisfactory, and frees the high-voltage impulse generator for other work.

(More Operation & Test on page 102)

NEW CONCEPT In Street Lighting Controls

LAMPLIGHTER

PHOTOELECTRIC LIGHTING CONTROL



Model GD-10 **Actual Size**

1. Engineered in accordance with the proposed EEI-NEMA Specifications with twist-lock plug.
2. One unit combined with unique series of auxiliary equipment will handle *EVERY* controlled lighting requirement.
3. Maximum *PROTECTION* from surges, short circuits, overloads.
4. Components operate at fraction of their maximum ratings.
5. Normally *OPEN* relay with non-welding contacts . . . Positive make . . . rapid break . . . no contact bounce.
6. Inoperative during daylight hours . . . yet fail-safe.
7. External sensitivity adjustment for any light level requirements.
8. *PROTECTION* from false operation by time delay.
9. No thermal elements, no vacuum tubes, no transistors, no transformers to cause high heat or filament burn-out.
10. Modern shape — fully sealed against dust, insects, moisture.
11. Made and fully warranted by the Acme Wire Co., for over 50 years a leading manufacturer in the Electrical Industry.

Your nearest representative will be glad to furnish you with descriptive literature and prices. Write him today.

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ELECTRICAL UTILITIES DIVISION

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directly, accurately, swiftly without target boards, charts or tables

This newly patented Swiss-movement instrument measures sag in feet and inches to within 1% of accuracy. Applicable to any wire, regardless of span, tension or type and size of conductor, this precision watch has a logarithmic dial that measures sag by timing the third return of a mechanical wave. Fully guaranteed.

For complete information, write:

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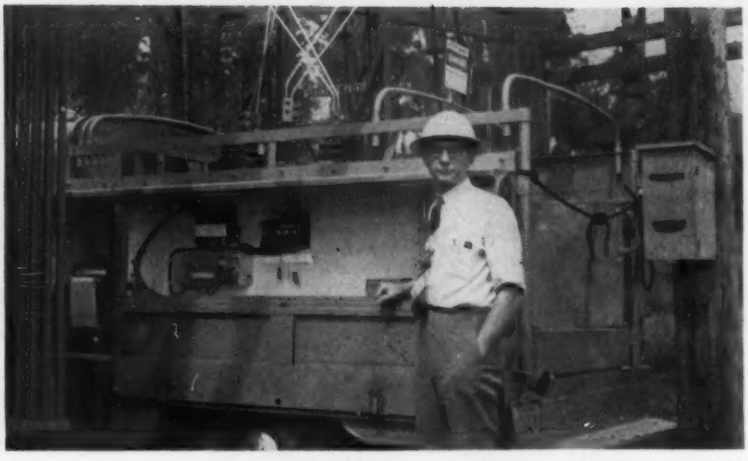
NOW...
TROUBLE-SHOOT TROUBLE SPOTS *FAST*
Save valuable Kw-hrs.

DICE MICROHM METER

Favorite of leading utilities for all low-resistance measurements on material tests, circuit breaker contacts, bus bar connections, cable joints.

MEASURES DOWN TO *ONE* MICROHM!

J.W. DICE CO. ENGLEWOOD, N.J.



Mobile Unit Tests Substation Load

*R. A. **BLACK**, Supervisor, Meter and General Engineering,*

*J. R. **GILBERT**, Meter Engineer, West Penn Power Co, Connellsville, Pa.*

Truck-mounted metering units provide West Penn Power Co with kw and kvar metering at substations where instrument transformers have not been installed. Four voltages—4.8 and 7.2-kv delta and 8 and 12-kv star—can be metered with the units.

Each unit contains three CT's and bushings, with transformer secondaries tapped for 100/5 and 200/5 ratios. Two 60/1 PT's have extended secondaries to provide a 40/1 ratio for 4.8 kv. Potential transformers are connected to phases "A" and "C" and the common is brought out by a fully insulated potential bushing. External connections may be made to phase "B" for delta circuits or to grounded neutral for star circuits. The instrument transformers are housed in a steel case, oil insulated for 15 kv.

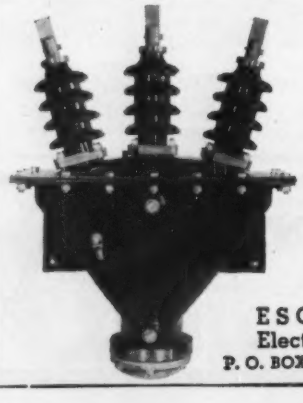
A 2½-element curve-drawing graphic kw meter, mounted in a sponge-rubber-lined rack, records the load. The meter, using a timed reactiformer, registers kw for 15 min and kvar for 5 min. Switches select delta or star metering, phase rotation, and lag or lead kvar. If necessary, zero may be displaced to record kvar of loads where the power factor changes between lead and lag.

A standard test switch is included to facilitate connecting of check meters and graphic voltmeters. Current ratios may be changed under load.

A rack, anchored to the truck bed, supports six 4/0 buses with ends 10 ft above ground. The buses are identified source and load. The rack also supports a 4/0 equipment ground bus.

The unit is connected in series with reclosers by removing the load leads and bridging the openings with jumpers. Because the reclosers may be taken out of service without interrupting the circuit, "hot" work is avoided.

An experienced 3-man crew can change circuits at the same location in 2 hr. Considerable time is saved over installing separate transformers, doing the secondary wiring, and providing shelter for the meter. ◀



ESCO

DRAWN STEEL POTHEADS

In All Standard Body Shapes—and Sizes to 15000 Volts.

Detachable Porcelain Potheads at Cemented Porcelain Prices.

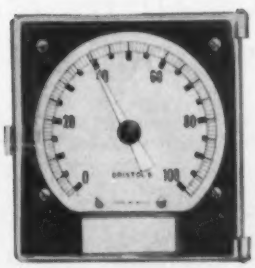
Write for Prices—and Delivery. Both are better than most.

ESCO MANUFACTURING COMPANY
Electrical Power Distribution Apparatus
P. O. BOX 1039, GREENVILLE, TEX. Ph. GL 5-6234

Motor drive gives these miniatures high torque, unusual accuracy

No galvanometer type drive here!

Bristol Series 663 Miniature Electronic Dynamaster* Recorders and Indicators employ a two-phase, motor-driven, slide wire self balancing principle. Here's plenty of torque for operating alarm contacts, electric control contacts, or retransmitting slidewires. Dead band is only 0.15%. Here, too, is twice the accuracy . . . ½% of scale . . . you get in ordinary miniatures.



SAME INSTRUMENT also made as an indicator, interchangeable with recorder of similar characteristics in 10 seconds. Actual size: 5" x 5¼".

Full plug-in flexibility, too. You can interchange chassis of the 663 in 10 seconds . . . replace it with either recorder or indicator instruments . . . both plug in easily without tools. Chassis also pulls out to intermediate position for chart changing and inking without disconnecting from circuit. Easy range change, too.

These features simplify planning of graphic control panels. They permit centralized recording and/or indicating of a large number of variables in minimum space. 15 miniatures mount in less space than two full sized units. Human engineering makes 3" charts and dials easy and accurate to read.

Remember, too, only Bristol offers full lines of both full size and miniature instruments. You can count on unbiased recommendations and dependable instrumentation from Bristol. The Bristol Company, 116 Bristol Road, Waterbury 20, Connecticut. e.12

*T. M. Reg. U.S. Pat. Off.

BRISTOL TRAIL-BLAZERS IN PROCESS AUTOMATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

BIG NEWS!

ROECLAMPS®

with associated cables

NOW FOR 15 KV

1. TURN THE NUT... and open. A few seconds—and the Roeclamp is on the messenger.

MINIMIZE TREE PROBLEMS, REDUCE OUTAGES, SAVE 75% OVER SELF-SUPPORTING CABLES

When Roeclamps with Associated Cables were introduced recently for 5 kv and 8 kv systems, the response was immediate and tremendous. Now the same advantages of greatly reduced cost, much easier installation, compactness, added attractiveness, greater current-carrying capacity, easy servicing, and virtual elimination of outages caused by falling limbs, are available for 15 kv systems with new 15 kv Roeclamps with Associated Cables.

The pictures show you how easy installation of each Roeclamp is, even with "boxing gloves" on. It takes under a minute, without tools. Phase identification is positive at a glance, since all cables are in the same relative position all along the line. What's more, you can add phases, or remove them, and the system can be reinforced, without *removing Roeclamps from the messenger!*

And what can you expect when Roeclamps with Associated Cables are in operation? Better voltage regulation, for one thing, because of low reactance. Higher current-carrying capacity, too. And the strong messenger practically eliminates outages caused by falling limbs or lightning. Conductors are available in copper or aluminum. Roebling's engineers will be happy to select the best insulation for your application.

In a nutshell, if you have a 15 kv system, or are contemplating one, get the vital facts about new 15 kv Roeclamps with Associated Cables now. Your Roebling representative will gladly demonstrate the Roeclamp. Just give him a call—or write Electrical Wire Division, John A. Roebling's Sons Corporation, Trenton 2, N. J.

ROEBLING

Branch Offices in Principal Cities
Subsidiary of The Colorado Fuel and Iron Corporation

2. **PUSH UP . . .** the Roeclamp is ready for conductors! They drop easily into place.

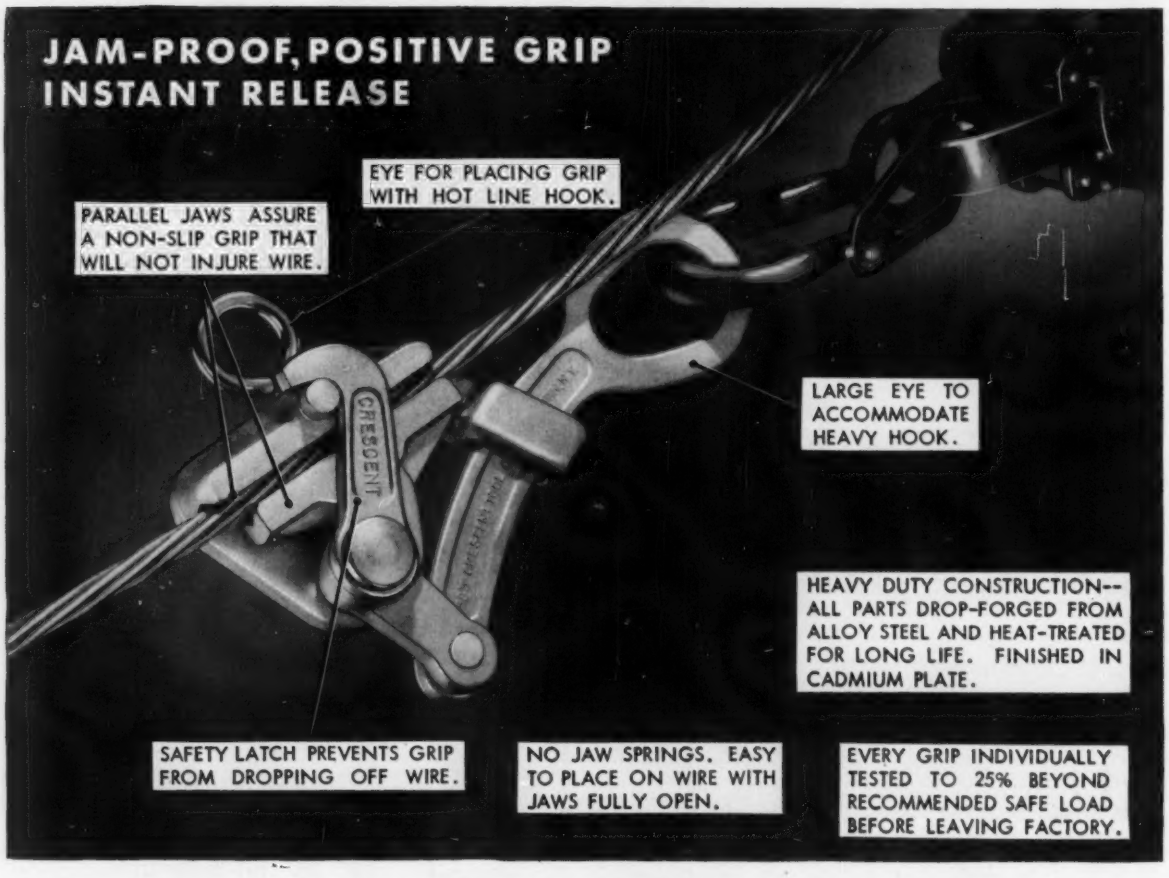
3. **CLOSE . . .** and hand-tighten. Roeclamp is completely installed—without removing gloves, and without tools!

About New 15 KV Roeclamps

They're strong—test to 1800 lb breaking strength! Tough Plexiglas* defies weathering, has top electrical properties. Conductors are at 7-inch centers for best electrical protection, easy installation. Roeclamps have unit construction, no separate parts. The big nut can be loosened readily, even with "boxing gloves" on. It hand-tightens. No tools required ever . . . no clamp is easier to install. And you never have to remove the Roeclamps for phase changes or repairs. Roeclamps come complete with grommets to fit the messenger and cables you order. Only 34 Roeclamps are required every 1000 feet.

*Reg. T. M.—Rohm & Haas Company

CRESCENT WIRE GRIPS


JAM-PROOF, POSITIVE GRIP
INSTANT RELEASE
EYE FOR PLACING GRIP WITH HOT LINE HOOK.
PARALLEL JAWS ASSURE A NON-SLIP GRIP THAT WILL NOT INJURE WIRE.
LARGE EYE TO ACCOMMODATE HEAVY HOOK.
HEAVY DUTY CONSTRUCTION-- ALL PARTS DROP-FORGED FROM ALLOY STEEL AND HEAT-TREATED FOR LONG LIFE. FINISHED IN CADMIUM PLATE.
SAFETY LATCH PREVENTS GRIP FROM DROPPING OFF WIRE.
NO JAW SPRINGS. EASY TO PLACE ON WIRE WITH JAWS FULLY OPEN.
EVERY GRIP INDIVIDUALLY TESTED TO 25% BEYOND RECOMMENDED SAFE LOAD BEFORE LEAVING FACTORY.
CRESCENT

SPECIFICATIONS

Number	*Maximum Capacity*	*Minimum Capacity*	*Safe Load*	*Eye Opening*	*Weight*
383 —Serrated Jaws	5/16 (.3125)" 8 mm.	—5/32 (.156)" 4 mm.	5,000 lbs. (2200 KG)	1-1/8" x 1-11/16"	1-3/4 lbs.
383-2—Same, except with smooth jaws for aluminum wire.					
384 —Serrated Jaws	1/2 (.500)" 12.2 mm.	—1/4 (.250)" 6.5 mm.	7,500 lbs. (3400 KG)	1-1/4" x 1-3/4"	3-5/16 lbs.
384-2—Same, except with smooth jaws for aluminum wire.					
385 —Serrated Jaws	3/4 (.750)" 19 mm.	—3/8 (.375)" 9.5 mm.	10,000 lbs. (4500 KG)	1-1/4" x 1-3/4"	4-7/8 lbs.
385-2—Same, except with smooth jaws for aluminum wire.					
386 —Serrated Jaws	1-1/16 (1.0625)" 27 mm.	—9/16 (.5625)" 14.5 mm.	12,500 lbs. (5600 KG)	1-5/8" x 2-3/8"	9 lbs.
386-2—Same, except with smooth jaws for aluminum wire.					

For bare and insulated wire, use serrated jaw style. For bare aluminum wire only, smooth jaws.

Write for Crescent Catalog which illustrates and describes many valuable tools for linemen and other electrical workers.

Crescent is our trade-mark, registered in the United States and abroad, for wrenches and other tools. Sold by leading distributors and retailers everywhere and made only by

CRESCENT TOOL COMPANY, JAMESTOWN, NEW YORK

Tool Speeds Slot Cleaning Operation

Generator slot-cleaning time is cut two-thirds by driving a special tool, made of three-cornered files, with a standard electric vibrating handsaw.

After generator iron is restacked, the top portion of the slots, where the wedges are driven, must be cleaned scrupulously to remove irregularities and ensure a smooth, tight fit for the wedges. Usually, this job is done by hand-filing, using three-cornered files of proper size to match the vee shape of each side of the slot.

When three hydro generators from Washington Water Power Co's Nine Mile station were brought in for partial restacking and rewinding, it was apparent the normal-hand-filing job would take too long. So Journeyman Electrician Delbert Yost devised a filing tool which fits snugly in the wedge part of the slot, will lock in the chuck of a vibrating handsaw, and is long enough to reach the entire 25-in. length of the slot from one side of the machine—necessary because the generators were stacked on side.

Yost's tool consists of two three-cornered files, with tines brazed to a 4-ft length of flat iron in such alignment that the files must be sprung together slightly to enter the slot, thereby maintaining snug pressure against the slot sides. The flat-iron end is locked in the vibrator's chuck.

With this tool, Water Power crews estimate slot cleaning can be done in one-third the manhours needed for hand-filing.

Utility Cuts Costs by Treating Used Line Poles

Virgina Electric & Power Co has been re-treating removed and standing poles for the past two years. Although it is too early to evaluate accurately the additional life obtained, Vepco believes the practices are worthwhile in reducing overall pole investment.

Poles pulled out of the ground are inspected. If they appear to be sound and have leached considerable creosote, they are sent to a plant for a 6-lb retention full-length pressure re-treatment. Poles that are sound, less than 8 yr old, and have not leached badly are reset without re-treatment. Soil around the pole is treated with 2 gal of creosote.

At present, the re-treating practice has been limited to poles in an area within about 75 mi of the creosoting plant. However the distance may be lengthened, depending on an economic study that is under way. During the past 2 yr about 5,000 used poles have been re-treated.

Standing poles have been re-treated using three preservatives: Osmoplastic, Pole Tox, and Cobra. The first two preservatives depend on osmotic action for penetration and the other is injected. These ground-line treatments have been applied to about 36,000 poles in the past 2 yr.

(More Maintenance on page 108)

Gully Emptier Pumps Sludge From Clogged Manholes

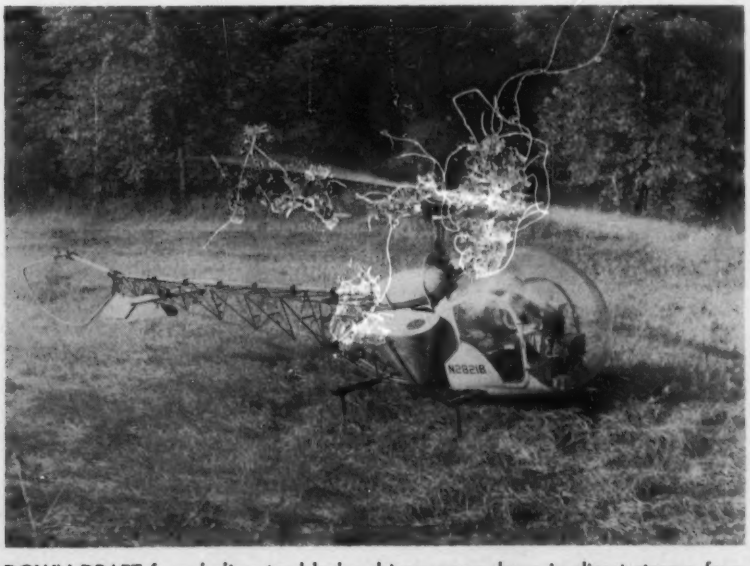
FRANK C. MARSCHNER, *General Superintendent of Underground Lines, The Detroit Edison Co, Detroit, Mich.*

Sludge is removed from manholes by Detroit Edison Co crews with a British-designed gully emptier which was recently mounted on an American truck chassis.

A suction pipe with operating valve is dropped into the manhole. An 885-gal tank is divided into four compartments to carry sludge, surplus water, cooling water and resealing water. A water-seal type vacuum pump exhausts air from the sludge compartment.

Sludge is pumped into the sludge compartment and a hydraulic pusher plate, located in the compartment, compresses the sludge. It is discharged from the sludge tank through a rear door. This method of removing sludge and cleaning out manholes has reduced the time required for doing the jobs and improved employee relations in the manhole cleaning group by eliminating most of the heavy labor and the undesirable features from one of the less desirable jobs.

Use Helicopter to Spray Right-of-Way



DOWN DRAFT from helicopter blades drives spray down in direct stream from tanks. Three passes are made on a 100-ft strip; four when undergrowth is heavy

Flying 6 to 8 ft above the line, a helicopter recently sprayed right-of-way on Kentucky Power Co's David Falcon 46-kv line, on an experimental basis.

Working only in early morning and late evening when air currents are not strong, the helicopter laid 555 gal of chemical under a 13-mi line in a total flying time of 2½ hours.

The aircraft carries 60 gal of spray; enough for 9,000 ft of right-of-way. Three passes are made on a 100-ft strip; four when undergrowth is heavy.

Although spraying is still effective at 200 to 300 ft it was done from 60 ft or about 6 to 8 ft above the circuit. Down draft from the helicopter blades drives the spray down.

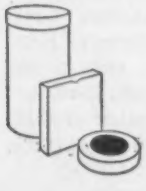
(More Maintenance on page 110)

Tape it easy, Mac!

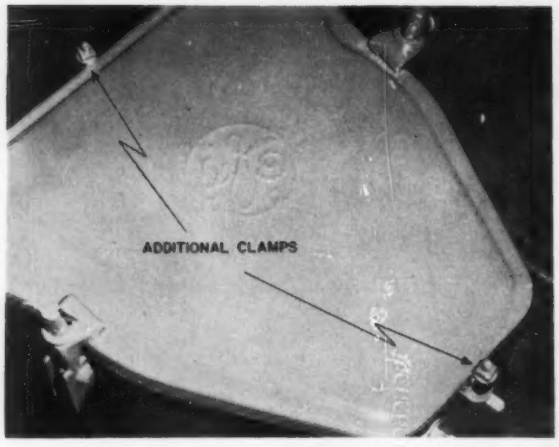
Gold Seal Tape sticks tight in any weather

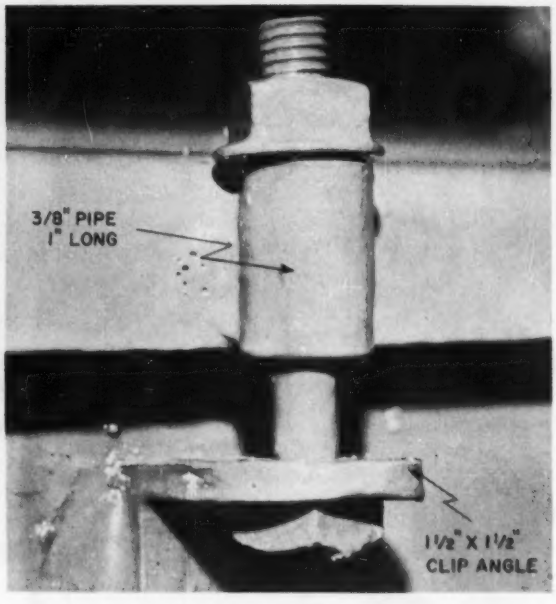
You can do a first-class insulating job — easier and faster — with Gold Seal Friction Tape. It tears evenly, conforms readily to uneven surfaces, sticks *tight* in any temperature and under all weather conditions. And one thickness *insulates.* For lasting "tack", for all-around insulation protection, ask for Gold Seal Friction Tape. Made by Jenkins Bros., Rubber Division, 100 Park Avenue, New York 17.

In 10-roll containers or single rolls • Each roll sealed in cellophane, stays fresh



Gold Seal FRICTION • *Rubber • Plastic Tapes...Commercial and Specifications Grades*





Clamps Stop Oil Leaks

T. W. GENTRY, Maintenance Man,
C. M. YOUNG, Transformer Repairman,
P. H. WHISTLER, Transformer Repairman, Ohio Power Co, Canton, Ohio

Oil leakage around covers of older distribution transformers can be easily eliminated by installing additional cover clamps. Two clamps are installed, one at the front and the other at the back of the cover. These additional clamps may be fabricated readily from scrap materials.

A 1-in. long piece of ⅜-in. pipe is welded to the cover as shown, and a 1½ x 1½-in. clip angle is welded to the tank. A $\frac{7}{16}$ x 3-in. machine bolt provides the pressure needed to make an effective oil seal. About ½ hr is required to install both clamps.

Reflective Numeral Markers Tag Transformers

Reflective numerals now are standard for identifying size and serial number on Washington Water Power Co distribution transformers. This is the latest use prescribed by the company for the adhesive markers.

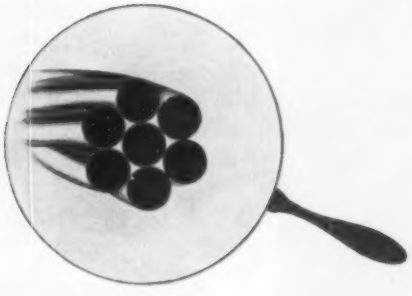
First use was in serial identification of company vehicles. After 3-yr experience, with good legibility and durability compared to standard stencil-painted numbers, the utility moved to numbering steel poles on downtown streets.

From there, the move to numbering pole-type transformers was a "natural." Crews have found the transformer's heat makes the markers even more sticky, ensuring a long-lived attachment. And it's easier to read the numbers from the ground.

(More Maintenance on page 112)

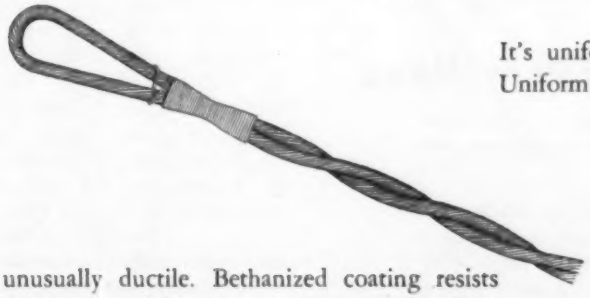
Why Bethanized Coating means full protection

Bethanized coating is the "armor" on Bethlehem strand.

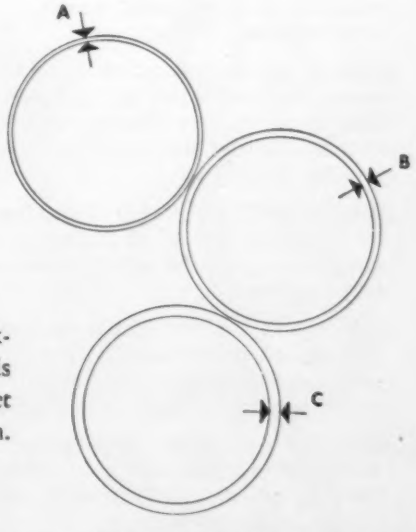


It's highly pure zinc, applied by a carefully developed electrolytic method.

It's uniform in depth. No vulnerable thin spots. Uniform application around each wire.



It's unusually ductile. Bethanized coating resists cracking, peeling, flaking, even under severe bending.



It's available on Bethlehem strand in three separate thicknesses—A, B, and C. A is equal to extra-galvanized. B is twice as thick; C, three times as thick. Thus you can get exactly the right protection for each individual installation.

For the most dependable protection, specify Bethlehem strand with the bethanized coating.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

Subox Has a Paint For Every Need

If it's a steel tower, for power transmission or any other purpose, there are Subox paints for every protective and decorative requirement.

SUBOX are the only paints in the United States made with *suboxide of lead*. After drying, Subox continues to be chemically active to form a strong, impervious film. A single coat of Subox usually lasts five to eight years even under severe weather conditions.

SUBOX "600" SERIES contains an epoxy resin for increased chemical, alkali and water resistance. Gives added protection against corrosive fumes and extremes in temperature changes.

GALVANOX, with a high content of special metallic zinc, provides an electro-chemical type of protection. Not to be confused with ordinary zinc oxide paints, it is superior for reconditioning damaged galvanized surfaces.

AEROX is the name used to distinguish the orange and white Subox-made paint used for towers near airfields. It holds its brilliant visibility well under all conditions.

Write today for descriptive literature and color card.

SUBOX PAINTS

Subox Inc.
Trade Mark

Established 1924
3 Fairmount Plant
Hackensack, N. J.

Aluminum Gin Poles Reduce Manpower

A special aluminum gin pole saves time and labor during the replacement of insulators and crossarms on the Tennessee Valley Authority system. The gin has two lengths of tubing connected to a "jack" in the middle, so that a heavy conductor may be raised and lowered easily. Secured to the bottom tube with a hinge is a plate that is fastened to the pole with a chain.

Previously, the conductor was raised using a hot stick and brute strength.

Plastic Aids Valves

*J. **REISLING**, Assistant Control Operator,*

*R. **CRUMBAKER**, Unit Foreman, Tidd Plant, Ohio Power Co, Brilliant, Ohio*

Saran, a clear pastic wrap familiar to every housewife, is protecting valve stems for Ohio Power Co. Seldom-used valves protected in this way are always ready for operation.

After advance cleaning and lubrication of the valve mechanism, parts are wrapped with Saran to protect them from dirt. Valves thus treated have operated without further attention. ◀

BODIES AND POWER EQUIPMENT DESIGNED AND MANUFACTURED BY ONE COMPANY---HOLAN

Order bodies and equipment from one source . . . where the responsibility for design, workmanship and warranty rests with one company.

ELBOWS

Single- and twin-bucket units with exclusive cable-type control system. For street lighting, tree trimming, transmission, distribution and telephone work. 360° continuous rotation.

HOLAN MAKES UTILITY, LINE CONSTRUCTION AND SERVICE BODIES—

all of high-tensile steel

EARTH BORERS

Two- and 3-speed. Portable; hydraulic or mechanical. Augers for 8″ to 30″. Dig holes 10′ deep. Power feeds for full line of hydraulic derricks.

TWO-LEGGED DERRICKS

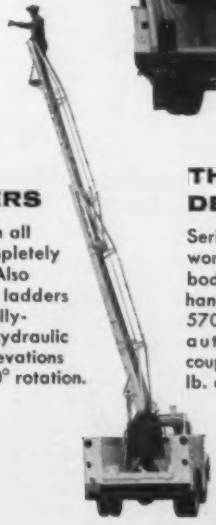
Series 6800 for more power in low ranges; lifts 8,000 lbs. (extendible boom head is optional). Bow-legged Series 6700 also lifts 8,000 lbs.

JACKS

Mechanical or self-stowing hydraulic jacks with 14,000-lb. capacity. Controlled from rear of truck.

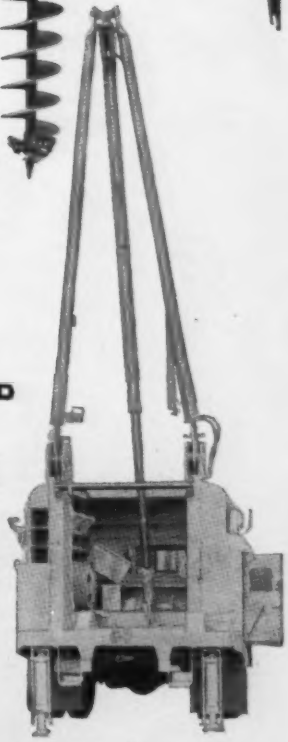
LADDERS

To 40′ with all phases completely hydraulic. Also mechanical ladders and manually-operated hydraulic ladders. Elevations to 75°, 360° rotation.



THREE-LEGGED DERRICKS

Series 3700 for heavy work. Lifts 12,000 lbs., body-loads 5,000 lbs., handles 75′ poles. Series 5700—available with automatic side leg coupling — has 6,000-lb. capacity.



TOWERS

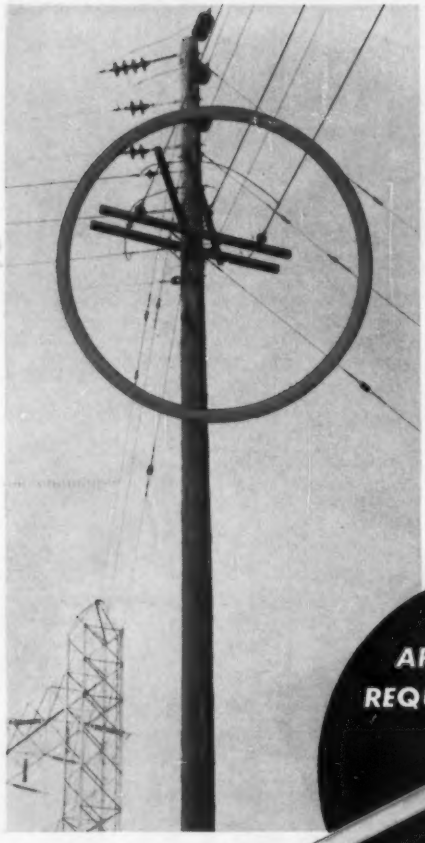
Hydraulic to 30′ high. Rotary, stationary or transverse platforms. Two- and 4-section and exclusive 5-section box-girder telescoping masts.

J. H. HOLAN CORPORATION

4100 WEST 150TH STREET
CLEVELAND 35, OHIO

OTHER PLANTS: **HOLAN CORPORATION OF GEORGIA**, Griffin, Ga.
J. H. HOLAN CORPORATION, PHOENIX DIV., Arizona
BRANTFORD-HOLAN LIMITED, Brantford, Ontario

THE NAME THAT MEANS WORK SIMPLIFICATION

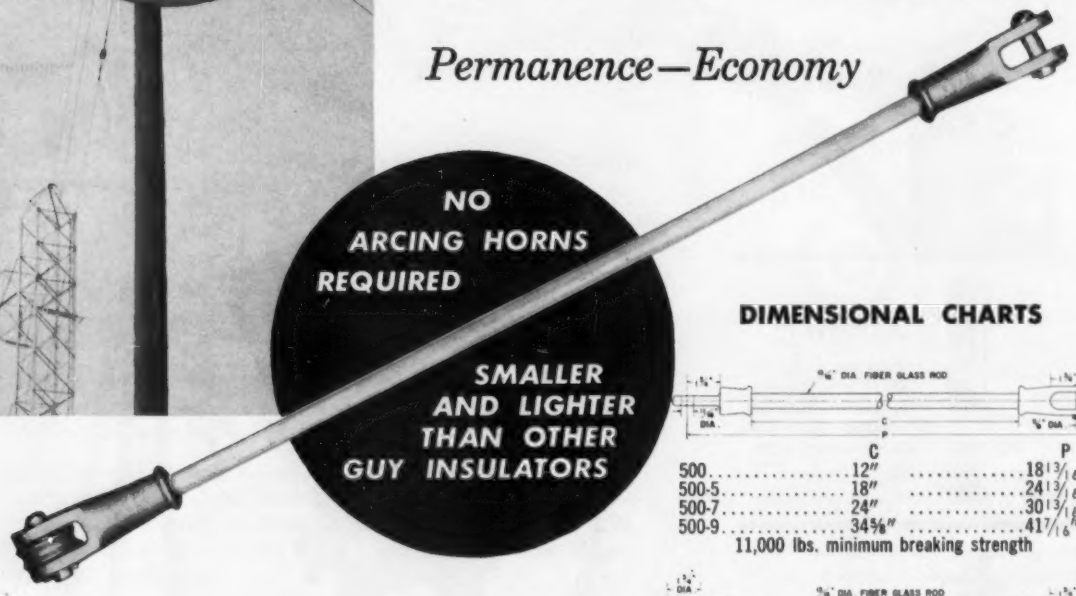


This Insulator Installs Quickly, Permanently . . .

EMPIRE FIBER GLASS GUY STRAIN INSULATORS

Strength—Insulation—Appearance

Permanence—Economy

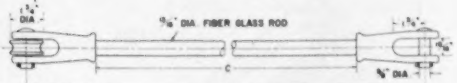


Glass-Strains are completely free from all voids and therefore provide excellent impulse insulation under wet or dry conditions. They were designed to match the tensile strength of popular guy strands and are very conservatively rated. The rod is manufactured by Empire Metal Products Co. using a large number of individual continuous glass strands under tension, which are bonded together with a highly weather resistant resin. The carefully tensioned glass fibers result in a rod which has a tensile strength equal to steel. Each Glass-Strain is actually tested beyond normal working load as part of the manufacturing procedure. Glass-Strains have been in service for several years and are being used in all parts of the United States.

DIMENSIONAL CHARTS

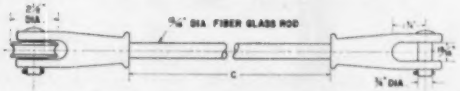
	C	P
500	12″	18 13/16″
500-5	18″	24 13/16″
500-7	24″	30 13/16″
500-9	34 5/16″	41 7/16″

11,000 lbs. minimum breaking strength



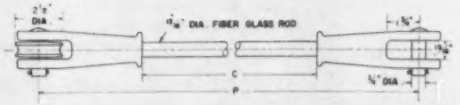
	C	P
650-24	24″	31 3/16″
650	34 5/16″	42″
650-5	54″	61 3/16″
650-7	78″	85 3/16″

15,000 lbs. minimum breaking strength



	C	P
703	34 5/16″	44 1/2″
703-5	54″	63 3/8″
703-7	78″	87 7/8″

21,000 lbs. minimum breaking strength



	C	P
800	34 5/16″	45 1/2″
800-5	54″	64 7/8″
800-7	78″	88 7/8″

26,000 lbs. minimum breaking strength

EMPIRE METAL PRODUCTS CO.
5443 West Roosevelt Road
Chicago 50, Illinois

MANUFACTURERS LITERATURE

To request literature, use code numbers indicated for each item when filling in Reader Service form facing page 127

BATTERIES

STATIONARY STORAGE BATTERIES . . . for power plants, presents recent studies of effect of temperatures on battery capacity, other information on selection and maintenance; 24 pages, Bul. 210, indexed. Exide Industrial Div, Electric Storage Battery Co, Box 8109, Philadelphia 1, Pa. C1

PLASTIC BATTERIES . . . for control, switchgear, and auxiliary power use. Bul. CP-540, 12 pages. Also Bul. CP-532, 12 pages on line of PlastiCell lead-antimony grid batteries for all stationary battery applications, from 10 to 1,650 amp-hr. C & D Batteries, Inc, Conshohocken, Pa. C2

CABLES

ALUMINUM RIGID CONDUIT . . . includes installation instructions, table of dimensions and weights of conduit, couplings, elbows. "Alcoa Aluminum Electrical Rigid Conduit," 12 pages. Aluminum Co of America, 749 Alcoa Building, Pittsburgh 19, Pa., or request copies from local Alcoa sales office. C3

AERIAL CABLE SUSPENSION CLAMPS . . . Roeclamps with associated cables designed as replacements for conventional pre-assembled self-supporting aerial cable; also replacement for open wire lines. Cat. J-942, 28 pages. John A. Roebling's Sons Corp, Trenton 2, New Jersey. C4

THERMOPLASTIC CONTROL CABLE . . . with polyethylene insulation and double Densheath (PVC) jackets, for 600 v, Anaconda 20-10, designed for general-purpose and station-control use. Recommended for d-c circuits, including those at elevated temperatures in wet locations. 6-page specification sheet, Anaconda Wire and Cable Co, 25 Broadway, New York 4, N. Y. C5

COATINGS

MAINTENANCE PAINTS . . . Capox, used on network transformers, in vault equipment, in steam condensate tanks to combat corrosion. Basically chemical condensation product of epichlorhydrin and bis-phenol. Tech Bul. No. 1, Subox, Inc, Fairmount Plant, Hackensack, N. J. C6

METAL TREATMENT . . . Ospho, to stop rust and prepare rusted metal for paint. Applied to rusted metal, it chemically changes rust into iron phosphate. 4-page bulletin. Rusticide Products Co, 3125 Perkins Ave, Cleveland, Ohio. C7

CONNECTORS

ALUMINUM . . . welding aluminum Delta-Star connectors to fit welded tubular connections, including laminated connections, expansion joints, T-connectors for tubing-to-cable joints, and a series of terminal lug connectors for stranded cable and for SPS tubing. Bulletin 38-E, Section II. H. K. Porter Co, Inc, Delta-Star Electric Div, 2437 Fulton St, Chicago 12, Illinois. C8

UNDERGROUND FITTINGS . . . connectors and accessories for complete line of underground fittings for use with distribution networks and other underground applications. Consist mainly of pre-insulated connectors known as Microns and Crabs. Catalog UG 53-1, 72 pages. Dossert Mfg Corp, 249-255 Huron St, Brooklyn 22, New York. C9

CONTROLS

CENTRALIZED CONTROL SYSTEMS . . . panelgraphs and panelboards. Brochure on the Panellit project engineer's approach to design, installation, and maintenance. Bulletin 106, 16 pages. Panellit, Inc, 7401 N Hamlin Ave, Skokie, Ill. C10

DISTRIBUTION

TYPE HR AUTOMATIC RECLOSERS . . . single and 3-phase units rated 14.4 kv and 23 kv, full complement of coil ratings. For suburban and rural distribution systems. Bul. GEA-6671, 8 pages. General Electric Co, Schenectady 5, New York. C11

AIR SWITCH . . . Type PV, rotating insulator, vertical break air switch from 7.5 through 69 kv, 600 and 1,200 amp continuous current. Furnished as 3-pole switch, also available as single-pole, 2, 4 or 5-pole units. Bul. PSEI, 12 pages. Line Material Industries, McGraw-Edison Co, Milwaukee 1, Wisconsin. C12

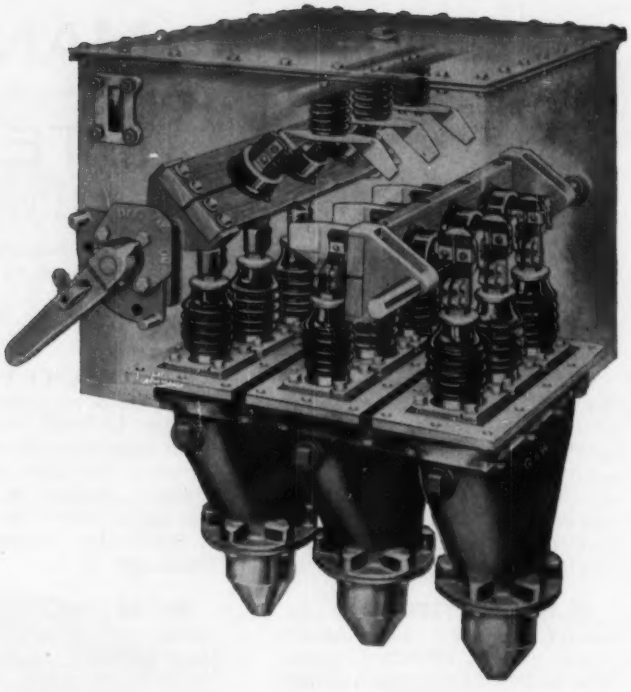
INSTRUMENTS

RESISTANCE THERMOMETERS . . . Thermohm temperature detectors for temperatures up to 1,000 F. Assemblies, accessories, listing of specifications by application and design. Special section on precision resistance thermometers for laboratory work involving temperatures from −261 to 500 C. 36-page illustrated catalog, EN-S4. Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pennsylvania. C13

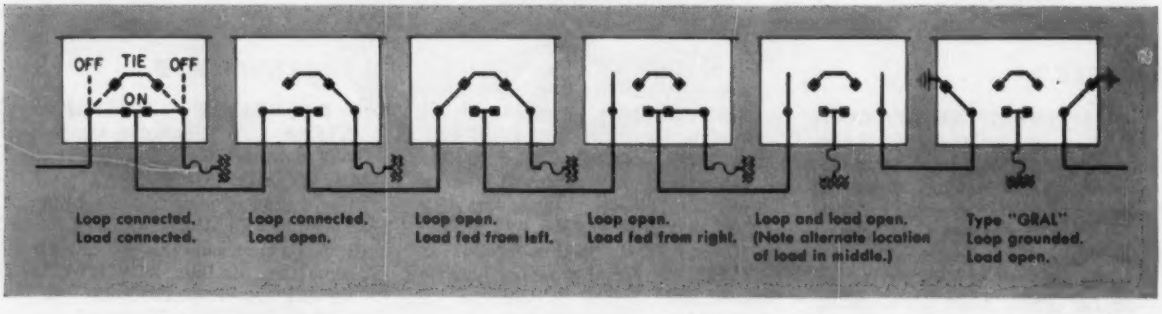
MOTORS

OPEN-TYPE MOTOR . . . Super-Seal, available in all integral-horsepower frames. Motor protection for larger sizes: Silco-Flex. For smaller sizes, encapsulated stator design. Bulletin 05-51B9040, 6 pages. Allis-Chalmers Mfg Co, Milwaukee 1, Wis. C14

STARTERS . . . for squirrel-cage type, high-voltage induction motors. Front accessibility, externally operated gang isolating switch, rollout feature. Bulletin 3300-PRD-249. Electric Machinery Mfg Co, Minneapolis 13, Minn. C15



low cost, unexcelled system flexibility


OFF
TIE
OFF
ON
Loop connected. Load connected.
Loop connected. Load open.
Loop open. Load fed from left.
Loop open. Load fed from right.
Loop and load open. (Note alternate location of load in middle.)
Type "GRAL" Loop grounded. Load open.

VOLTAGE CHARACTERISTICS

voltage rating	60 cycle withstand dry	impulse withstand 1½ x 40 wave
7.5kv	36kv	95kv
15.0kv	50kv	110kv
23.0kv	70kv	150kv
34.5kv	95kv	200kv

CURRENT CHARACTERISTICS

ampere rating	switch	amperes	
		momentary	4 seconds
400	standard	20,000	15,000
	special*	30,000	19,000
1000	standard	40,000	35,000
	special*	50,000	40,000

standard contacts silver plated
*silver inlaid contacts

Where maximum flexibility is demanded in a distribution system, the Type RAL oil switch has no equal. A few of the connections made possible with it are shown above.

The RAL load break oil switch is designed for three ways (two feeders and one load). The ways, links and tie buses are so compactly combined that only one RAL switch is needed to do the job of three conventional type switches. Costs are reduced accordingly—for equipment, installation time and space requirements. Maintenance expense is always far less for a quality product, too.

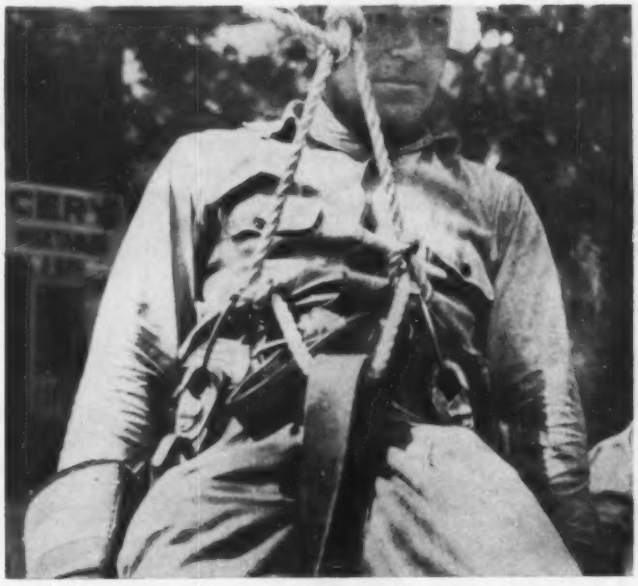
Standard RAL switches are made in 400 ampere (full load break) rated 600 volts, 7.5 kv and 15 kv. Special designs are made for 23 kv and 34.5 kv and for 1,000 amperes.

You can't afford to overlook the opportunity to learn more about this G&W switch. Contact a G&W representative about it today.

G&W ELECTRIC SPECIALTY COMPANY
3500 W. 127TH STREET • BLUE ISLAND, ILLINOIS

CANADIAN MFR. • POWERLITE DEVICES, LTD. • TORONTO, MONTREAL & VANCOUVER

D584



Victim straddles safety strap . . .

Rescue Sling Proves Best

H. E. HATFIELD, General Supervisor Safety, Georgia Power Co, Atlanta, Ga.

A pole-top rescue technique involving use of the victim's safety strap and a line to make a sling has been developed by Georgia Power Co. Use of the sling at the lower part of the victim's trunk provides positive control and eliminates compression of the chest from a loop under the arms, thus facilitating breathing. Also, the sling method eliminates chafing caused by a rope.

The rescue method is used whenever a lineman contacts a hot conductor, regardless of whether he is conscious or not. When the victim is unconscious, the first lineman reaching him gets in position, placing his safety strap between the victim's legs. By raising up, the lineman seats the victim on the safety strap, releasing the victim's strap. After the victim's body belt is pushed up, resuscitation using the pole-top method is started, if the victim is not breathing properly.

While resuscitation continues, a second lineman rigs a line over a crossarm, above the victim and passes one end of the line through both D-rings on the victim's belt, tying an overhand knot at each ring. The loop is completed with a bowline. Next, the lineman detaches an end of the victim's safety strap and passes it under one of the victim's legs, through the rope loop, and finally under the other leg back to its D-ring.

The resulting sling assures positive control of the victim without discomfort by supporting the victim's hips with his safety strap and his back with his body belt. Thus, the sling can be used to help hold up the victim during resuscitation and later to lower him, whether conscious or not.

Company policy forbids lowgering a victim who is not breathing, unless he is dead. This policy assures that resuscitation is started as soon as possible, rather than delaying it until the victim is lowered to the ground. The

(*Continued on page* 118)

first lineman starts resuscitation . . .
second man rigs line for sling

SALISBURY'S UBANGI SYSTEM

FOR THE PROTECTION OF LINEMEN AGAINST ACCIDENTAL CONTACT WITH ENERGIZED CIRCUITS

APPLIED AND REMOVED WITH HOT LINE TOOLS

A one man operation.

- HIGH DIELECTRIC
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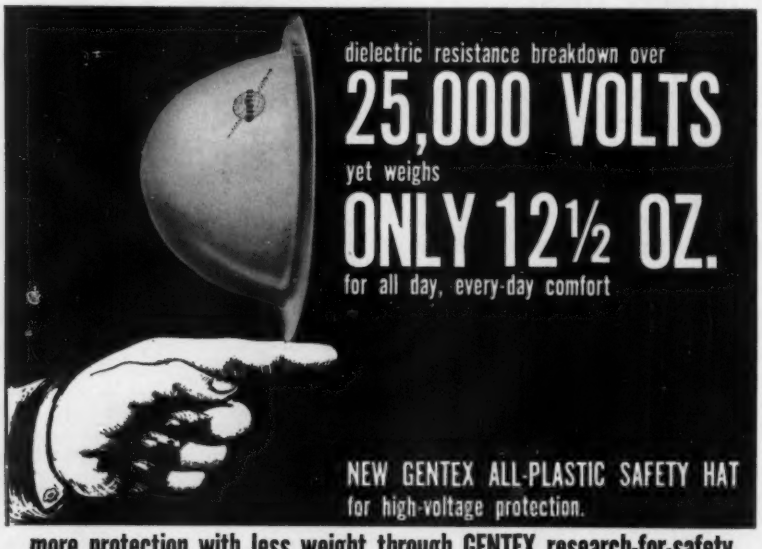

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Rescue Sling Works Best *(Cont.)*

savings in time could mean the difference between life and death. Prompt resuscitation also lessens chances of damage to the brain.

The one exception to the policy would be if a medical doctor deemed lowering necessary. Should this occur, the victim would be raised slightly to release some weight from the resuscitator's safety strap. Then the two linemen would climb down

Conductive Plugs Adapt Overshoes for Working 345 Kv Hot

*P. A. **BULLOCK**, System Supt. of T&D Operations,*

*R. B. **CHAMBERS**, Supvr. of Transmission Line Maintenance, Indiana & Michigan Electric Co, Fort Wayne, Ind.*

Ordinary overshoes may be adapted with conductive rubber plugs to provide conductive footgear for line crews in cold weather. Overshoes with these plugs, when worn over conductive-soled shoes, effectively drain static charges when the lineman is working in the strong electrostatic field of a 345-kv line.

The plugs, molded to specification by a rubber company, are inserted in ¼-in. holes drilled in

slowly, one continuing resuscitation as the victim is lowered and the other moving down the resuscitator's strap.

A victim can be lowered about twice as fast using this method as with a loop under the arms because the victim can be supported entirely by the sling without impeding breathing. In the old method, some of the victim's weight was supported on the resuscitator's strap to avoid compressing the chest too much by the line. This weight slowed the process of moving down the resuscitator's strap.

Another advantage of the new method concerns the changing of resuscitators. Because the victim can be raised without impeding breathing, linemen can swap positions more easily.

The diaphragm method of resuscitation has been adopted. The company believes this method minimizes the possibility of contacting a hot conductor, as could more easily occur with the arm-raise method.

The rescue sling was developed by A. H. Dowd and his line crew during their monthly pole-top resuscitation practices.

the overshoe sole and cemented in place with rubber cement. The plugs are cut to length with diagonal pliers after insertion. Approximately 70 to 80 plugs are required per pair depending on the size of the overshoes.

Material costs per pair are about $5.60 with 2 man-hr of labor required to install the plugs.

Sliding Legs Make Ladder-Work Safe

Ladder safety is increased for San Antonio Public Service Board service and meter crews through the use of a ladder leveling device that attaches to the bottom of the ladder. Sliding action of metal rod in a metal tube permits ladder legs to be extended to different lengths to fit ground conditions where the ladder is being used. A locking device locks the legs in position when a man steps on the bottom step of the ladder.

The ladder leveler is particularly helpful when there is irregular ground, such as flower gardens, cellar window wells, or uneven sidewalks, in the vicinity of meters or where services are to be installed.

A swivel bottom adjusts to the footing. A rubber base assures freedom from slipping. ◀

Whether it's tool belts or safety straps . . . pliers or wrenches . . . grips or climbers, linemen and electricians know they can expect the highest in quality when their equipment carries the name Klein.

For more than a century Klein has been the leader in designing and producing tools and equipment to serve the exacting needs of the utility field.

Today, wherever power lines or communication lines are strung, Klein tools and equipment are in greater demand than ever, assuring safer, speedier line construction and operation.

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A free copy of the new Klein Pocket Tool Guide will be sent on request.

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WITH A *Rolatape* MEASURING WHEEL

Take all your outdoor measurements this modern, time saving way. ROLATAPE reduces the risk of human error, since it records precise measurements in feet as it is rolled along—automatically and in full view of the operator. Sturdy, lightweight; equipped with automatic brake and built-in stand. Handle folds compactly.

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BOOKS

Fundamentals of Electricity

Basic Electricity, Second Edition. By P. B. Zbar & Sid Schildkraut. Published by McGraw-Hill Book Co, 330 West 42nd St, New York 36, N. Y. 97 pages, illustrated. Price $2.25.

The fundamentals concerning resistance, inductance, and capacitance are adequately covered in this laboratory manual. Could prove useful to those organizations which have a formal training program for testers and electrical maintenance men.

The Art of Speaking

Practical Speaking for the Technical Man. By J. E. Dietrich and Keith Brooks. Published by Prentice-Hall Inc, 70 Fifth Ave, New York 11, N. Y. 306 pages, illustrated. Price $6.60.

Many helpful hints on practical speech making can be obtained from this book written by two speech teachers. Although fundamentals are presented, much of the information is oriented to the needs of the technical man. The authors discuss their subject in a clear and logical manner that should appeal to the technical man.

Electronic Fundamentals

Basic Electronics, Second Edition. By P. B. Zbar and Sid Schildkraut. Published by McGraw-Hill Book Co, 330 West 42nd St, New York 36, N. Y. 97 pages, illustrated. Price $2.25.

This is a laboratory manual prepared for radio and television technicians. It should however be of value to utility electronic specialists. The manual starts with material on tube fundamentals and carries on to complexities of advanced tube and transistor circuits.

Pictures of Computers

Basics of Digital Computers, Vol. 1, 2 & 3. By J. S. Murphy. Published by John F. Rider Publisher, Inc, 116 West 14th St, New York 11, N. Y. 416 pages, illustrated. Prices $2.50 per volume . . . 3 volume set $6.95.

These three volumes give a "picture story" of computers. Volume one covers the fundamentals, volume two the logical elements and circuits, and volume three the large system aspects of computers. The author describes most of his material with pictures but nevertheless the reader will need some background in electronics in order to use the books. With this necessary background the reader will get an excellent survey course on computers.

How to Be a Manager

You and Management. By D. R. Davies and R. T. Livingston. Published by Harper and Brothers, 49 East 33rd St, New York 16, N. Y. 264 pages, illustrated. Price $4.50.

This practical book should help many in ascertaining their qualifications for management. It discusses the position and performance of managers and their relationship to their organization and society. The book is clearly written and humorously illustrated.

Practical Supervision

How To Supervise People, Fourth Edition. By A. M. Cooper. Published by McGraw-Hill Book Co, 330 West 42nd St, New York 36, N. Y. 244 pages. Price $4.95.

Written by an industrial training specialist, this book presents practical facts about supervision. Hiring, discipline, teamwork, accident prevention, training, etc . . . are all covered in an easy-to-read style. New material on automation, communications, and human relations has been added in this new fourth edition.

Books Recently Received

Steam Turbine Performance and Economics. By R. L. Bartlett. Published by McGraw-Hill Book Co, 330 West 42nd St, New York 36, N. Y. 308 pages, illustrated. Price $12.50.

Weather and Climate. By C. E. Koeppe and G. C. De Long. Published by McGraw-Hill Book Co, 330 West 42nd St, New York 36, N. Y. 322 pages, illustrated. Price $7.50.

UTILITYMAN'S GUIDE TO CABLE SPLICING MATERIALS

What method do your men use to splice cable? How do they insulate joints? What kinds of materials do they use? What type of connectors?

One way to help keep construction costs, operating costs, and maintenance costs down is to make sure your workmen continue to use up-to-date splicing methods. That's why Rome Cable makes available information that can help your crews do a better job—faster.

Take the table on this page, for example . . . it tells *at a glance* what splicing materials are used for power cables. Extra copies of this table are available from your Rome Cable salesman. He is your contact for more information about the most effective materials and methods for cable splicing.

Your guide to *better* cable splicing is your Rome Cable salesman—he stands ready to help with *all* your wire and cable problems. Why not call him in today?

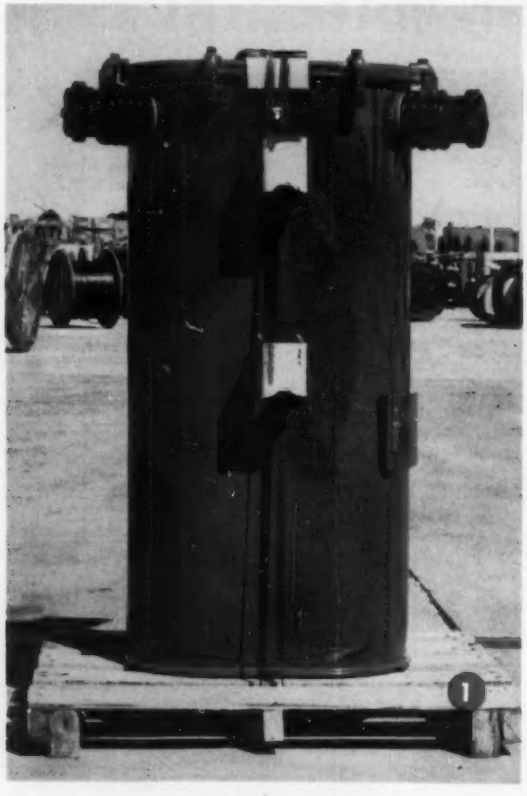
DESCRIPTION AND PURPOSE OF MATERIALS	Rubber Insulated Lead Covered	Rubber Insulated Neoprene Jacketed	Rubber Insulated Thermo-plastic Jacketed	Thermo-plastic Insulated Thermo-plastic Jacketed
1. Lead sleeves—for housing the joint-cut from commercially pure lead tubing.	X	..	..	..
2. Copper connectors—slotted, tinned and beveled—for joining the conductors made in accordance with electrical industry standards.	X	X	X	X
3. Compression-type connectors—either copper or aluminum—used with hydraulic press and die.	X	X	X	X
4. Solder—for making wiped joints and soldering the connector, standard 60-40 grade.	X	X	X	X
5. Stearine—soldering flux.	X	X	X	X
6. Sandpaper—for preparing factory applied insulation.	X	X	X	X
7. Wooden spatula—for applying rubber cement.	X	X	X	..
8. Special cement—for use under first layer of insulating and jacketing tapes in joints on rubber insulated and neoprene jacketed cable.	X	X	X	..
9. Cable paint—for painting over the entire joint.	..	X	X	X
10. Cotton tape—for cleaning connectors, protecting and securing cable insulation, and for temporary lashing.	X	X	X	X
11. Ozone-resistant tape—for insulating joints on rubber insulated cables.	X	X	X	..
12. Neoprene tape—for forming a jacket over joints on rubber insulated neoprene jacketed cables.	..	X	..	..
13. Friction tape—for protecting and securing hand-applied rubber insulation in joints on rubber insulated cables.	X	..	..	..
14. Anhydrous tape—for over-all protection of joints.	X	X	X	X
15. Polyethylene-base tape—for insulating joints on polyethylene insulated cables.	..	..	..	X
16. Pressure-sensitive thermoplastic tape—for insulating and jacketing joints on thermoplastic insulated or jacketed cables other than polyethylene.	..	..	X	X
17. Shielding braid—⅝″ woven copper tinsel tinned braid—for shielding joints.	X	X	X	X
18. Grounding wire—Tinned copper—8, 10 or 12 AWG flexible strand.	..	X	X	X
19. Insulating compound—for filling the lead sleeve. An asphaltic base compound with suitable melting point, high dielectric strength and low dielectric loss.	X	..	..	..

This table was taken from the second edition of the 393-page Rome Cable Manual of Technical Information. This new book is packed with up-to-date data on cables and materials. It contains almost all the information you need to specify, purchase, and use wire and cable. You can get your copy of the new edition by mailing $4.62 to Dept. 191-C, Rome Cable Corporation, Rome, N. Y. *Remittance must accompany your order.*

ROME CABLE

CORPORATION

KEEP THIS AD FOR FUTURE REFERENCE • TEAR ALONG PERFORATION



1 **PALLETIZED TRANSFORMER** is easily marked, redistributed and issued. The problem of uncrating and waste disposal has been substantially reduced by this method

2 **TRANSPORTATION** of palletized transformers is accomplished without the usual delays. Although the transformers are more exposed, no breakage has occurred

3 **FORK-LIFT TRUCK** moves transformers quickly. Previously, a "C-hook" plate was placed across the forks and the transformer was lifted by a sling on the hook

Pallet Shipping Eliminates Transformer Uncrating

***S. L. KOSLOW**, Manager of Stores, Long Island Lighting Co, Hicksville, N. Y.*

Uncrating time has been virtually eliminated by the receipt of distribution transformers strapped to wood pallets instead of in conventional wood crates. This permits LILCO storekeepers to apply company identification, redistribute and issue the transformers as received from the vendor. It also reduces the waste disposal problem.

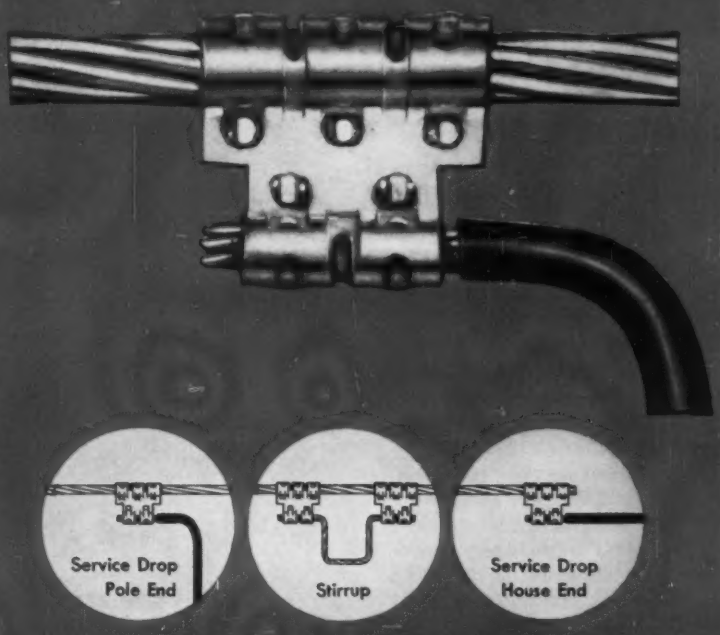
Strapping the transformrer to the pallet provides for more efficient movement by fork truck. Fomerly, uncrated transformers were moved by placing a "C-hook" plate across the works and lifting the transformer by a sling suspended from the hook. This method required a fork truck operator and a helper to hook the sling to the lifting lugs of the transformer. Now only the operator is required.

Although the transformers are now more susceptible to damage in transit the first two shipments have been received without incident and it is expected that proper lashing of the load will eliminate this possibility. Additional experience should result in further refinements to the pallet and method of strapping used in the first two shipments.

It will be necessary for vendors to build racks or shelves in their trucks and warehouses if they want to continue to "stack" transformers. However, this initial cost and the cost of lashing each load will be more than offset by reduced packaging costs and reduced shipping weight of each unit.

(More Stores on page 124)

The TAP that TOPS them all...



THE MULTI-PURPOSE A-MP UTILI-TAP®
for aluminum and/or copper conductors

Tired of all the expensive clutter in your stock rooms—a special tool for this, a special piece of hardware for that? Now you can clear out a lot of your inventory clutter with all new A-MP UTILI-TAP®.

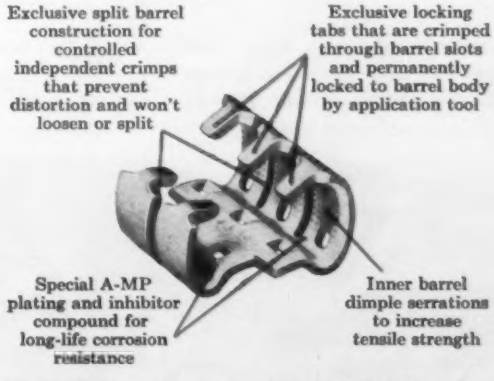
Here is a product that can be used on diverse tapping installations—like no other product on the market. It's permanent, it's sure and it will do many, many jobs.

Your stock can be simplified and easily maintained. Your linesmen can now go up the pole without pockets filled with miscellaneous parts or belts loaded with special tools. Simplify with the A-MP UTILI-TAP®.

Light-weight matched tooling available in mechanical or hydraulic types.

The only tap on the market that converts from an easily attached open barrel construction to a permanent, closed barrel attachment.

Look at these unbeatable features:


Exclusive split barrel construction for controlled independent crimps that prevent distortion and won't loosen or split
Exclusive locking tabs that are crimped through barrel slots and permanently locked to barrel body by application tool
Special A-MP plating and inhibitor compound for long-life corrosion resistance
Inner barrel dimple serrations to increase tensile strength

Full range of wire size combinations for aluminum, copper or ACSR conductors.

Send today for more information to solve your tap inventory and reliability problems simultaneously.

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GENERAL OFFICES: 181 HILLCREST AVE., HAVERTOWN, PA.

Exclusive Distributor For A-MP Products To The Utility Industry

Salvaged Pole Treatment Prolongs Life

Salvaged poles are given new life in Central Power & Light Company's storage yards before they are returned to service. Poles to be treated are placed on two old poles spaced for the purpose. Enough space is left between the poles to be treated so that treatment can be applied on one side and the pole rolled over for treatment on the other side.

Treatment consists of a generous application of a salve-like preservative. The preservative is applied with a brush or old broom that has had the handle shortened. Preservative is applied from 2 ft above ground level to 3 ft below ground level.

After preservative has been applied, poles are left in place for three weeks or more, allowing the preservative to be absorbed into the pole. The time required for this is longer when the weather is damp or rainy.

Several hundred poles have been treated. It is hoped that they will have an additional 12 to 15 years of life as a result of the treatment.

Store Mast Arms On Special Bunk-Bed Racks

Storage of street light mast arms has been improved in San Antonio Public Service Board's yard by development of a "bunk bed" type of storage facility. The "bunk bed" rack is built up by welding lengths of angle iron to sections of pipe. The racks are stacked one on top of the other, as required, by slipping a section of slightly smaller pipe inside the first pipe section with the small pipe section extending well above the other. Then, another rack is set on top of the first, the pipe sections slipping over the smaller pipes.

Storage racks are set one upon another as they are filled with mast arms and removed one from the other as mast arms are taken from storage. The build-up is on the principle of the bunk bed from which the rack takes its name.

Storing mast arms on the racks and removing them from storage is much easier than any other method of storing the Board has used before. ◀

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To learn more about:

- New Equipment announced in this issue . . .
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New York 36, N. Y.

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Readers Service

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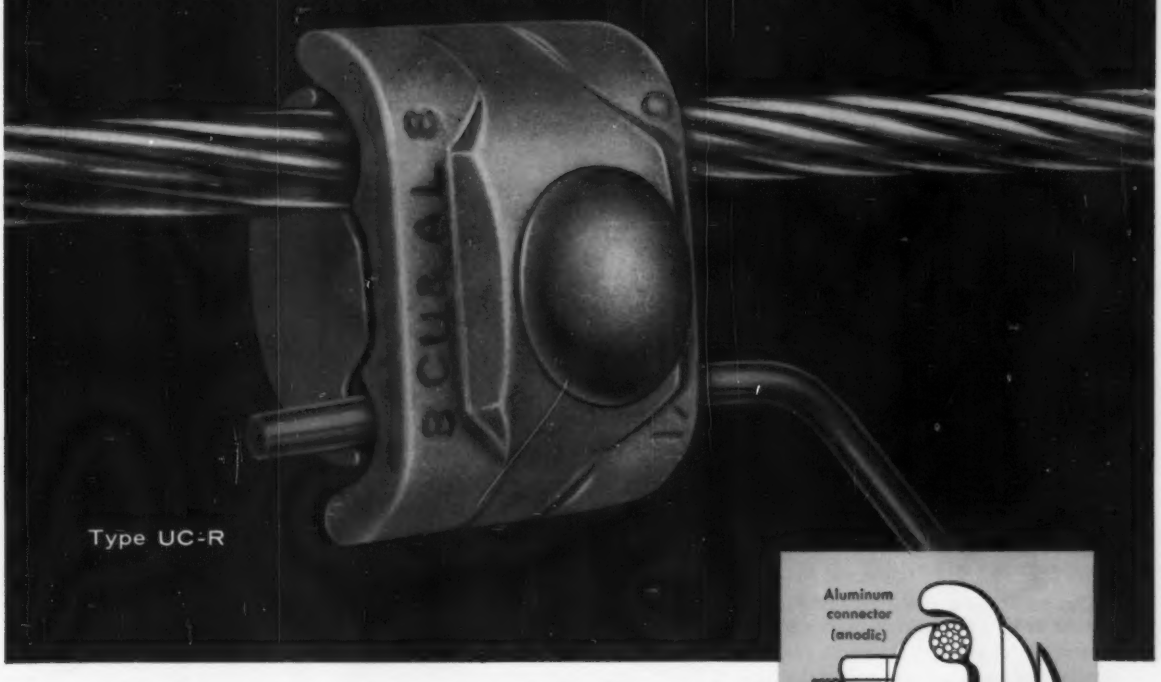
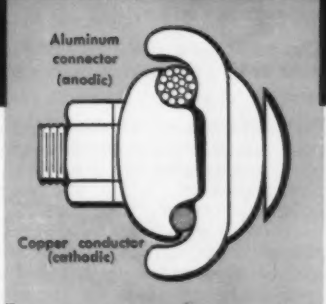
7. 9th Annual Forecast—*predictions on peak loads, capability, and energy use up to 1975.* (25¢)
8. Modernize Distribution — *helpful hints on how to improve distribution for future loads.* (25¢)
9. Modernize Service Functions—*latest techniques in data handling, stores, and communications.* (25¢)

We will bill you later for those reprints for which there is a charge. Quantity prices on request

TAPIT

connects Aluminum to Copper...
*better... for 35% less**





MASSIVE ALUMINUM TAPIT MINIMIZES CORROSION. The larger the mass of aluminum (anodic) compared to copper (cathodic), the less the galvanic corrosion in an aluminum-to-copper connection. Note massiveness of aluminum TAPIT connector in relation to copper conductor.

Field experience and extensive tests have proven that the massive aluminum TAPIT design withstands effects of galvanic corrosion better than copper-bushed or plated aluminum connectors on aluminum to copper conductor combinations.

*Massive aluminum design also... by eliminating need for copper bushings or special plating... saves at least 35% in cost of connectors for aluminum to copper.

Only five sizes required for joining any conductor combination in #8 thru 400 Mcm range. Stocking is simplified... TAPIT can also be used on aluminum to aluminum. Also available with PENETROX sealed in with STRIPSEAL.

Ask your Burndy representative how you can save 35% on aluminum to copper connections—and get better connections —or write directly to Burndy, Norwalk, Connect., or Toronto, Canada.

TAPIT® — *another engineered solution to your connector problems by*

BURNDY

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Norwalk, Connect. In Europe: Antwerp, Belgium Toronto, Canada

A 15-kv 400-amp station-type disconnect at a distribution disconnect price

No Sticking!...No Burning! No Pitting!...No Welding Shut!

Silver-weld contacts, a unique new development, provide 20,000 ampere momentary rating for this distribution disconnect

How is it possible to get this performance?

The answer lies in the methods of applying silver to the contact surfaces.

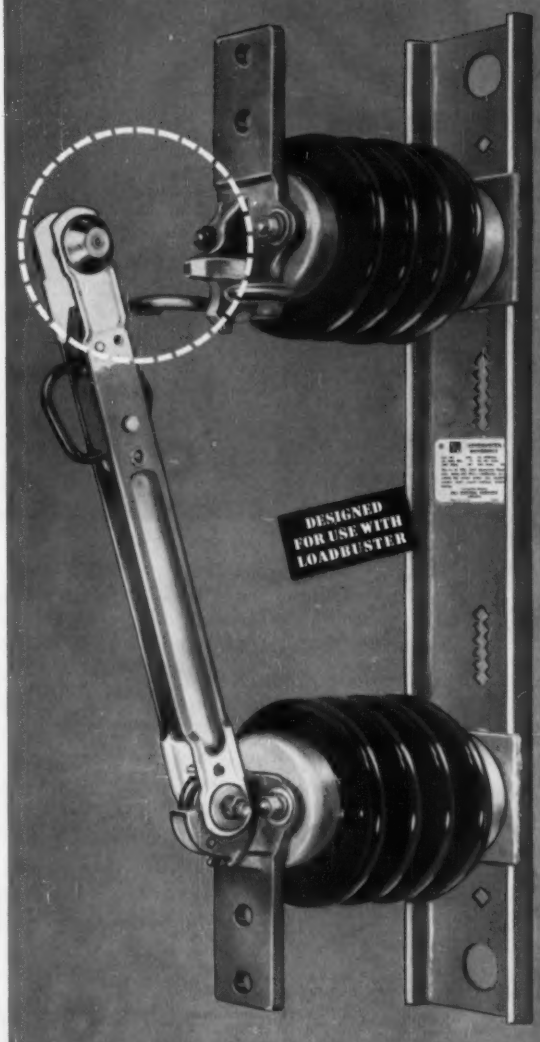
To apply silver to the contact castings, a new, patented process is used which includes special preparation of the contact surfaces, preheating them in a neutral atmosphere, fusing onto them molten particles of silver alloy, and then coining for hardness control, contour, and low porosity.

To apply silver to the blade, another method is used. The blade is silver-clad with extra-thick, high-density, low-porosity silver.

The result is a silver-to-silver contact which does not seize or gall and which makes possible the high current ratings.

But performance of a new disconnect is one matter, and performance after normal usage and exposure to atmospheric contamination is another. In practice, a distribution disconnect may be left in the open or in the closed positions for very long periods, with contacts exposed to corrosive atmospheres, typically without maintenance. Recognizing this fact, S&C has designed a disconnect that will carry its rated load, even after hanging open for long periods. On the other hand, this new S&C disconnect will open without difficulty, even after long exposure in the closed position.

And without extra cost, you get full load switching with LOADBUSTER® when you fit your distribution system with S&C LOADBUSTER Disconnects. Write today for Descriptive Bulletin 721, to S&C Electric Company, 4421 Ravenswood Avenue, Chicago 40, Illinois. In Canada: S&C Electric Canada, Ltd., 8 Vansco Road, Toronto 14, Ontario.



S&C LOADBUSTER® DISCONNECTS

Disconnects • Cutouts • LOADBUSTER® • Load Interrupters • Metalclad Switchgear • Fuse Links • Power Fuses

Specialists in High-Voltage Circuit Interruption Since 1910

Brings Automatic Station Closer (*Continued from page 45*)

version and monitoring and/or computing circuits.

5. The output, scaled in range and correct engineering units, goes to a typewriter or other printing device.

Such equipment can perform other operations besides logging data. It can compare data with a pre-set value and indicate audibly and visually, or print, any excess over the pre-set limits. It can compute algebraically the relationship of data to other variables.

Removes Human Error

Accordingly, a data-handling system relieves station personnel of menial and volumnous tasks, allowing them to perform more important jobs efficiently. And it removes human error from readings and comparisons of a variety of values. It simplifies panel instrumentation by eliminating the need for many recording and indicating instruments.

A data-handling system provides an orderly and automatic documentation; makes available an evaluation of each phase of station operation; affords immediately usable information for resetting to optimum efficiency; and, presents a history for reference in future calculations. The information in its programmed log sheets flows from a variety of sequential sources.

Aids Start-Up

A data system informs station personnel immediately of conditions at start-up, brings swift awareness of the development of a dangerous situation, acts to monitor trends in any area of the plant, and accurately records the whole process. It accomplishes calculations on related process data through its ability to perform addition, subtraction, multiplication, division, and square root extraction.

Automatic control is present to the extent that the data system poses for the operator several alternatives, supplying the data and computations for his intelligent choice of action. Moreover, the equipment protects costly plant investment through monitoring, off-normal alarming, and making immediately available important data and records.

The cost of data-handling equipment today is competitive with that of prevailing instrumentation methods.

Some allowance must be made in today's planning for the expansion of its applications later in the wholly automatic station. Thus design should envision today's efficiency and tomorrow's capabilities.

Operator Selects

But the wider application of the data-handling system will require development of primary sensing elements for showing moisture composition, enthalpy, radiation losses, etc., and, as more control programming becomes available, more advantages will be obtained through the use of the system as a computer-controller.

Today's data equipment computes, but leaves the perogative of selecting the control actions to the operator. But the alternatives for the operator's selection will contract as process unknowns can be compensated for or eliminated, so that ultimately the data system will be able to perform the control actions themselves.

Improvements Cited

Maintenance of data-handling equipment is now comparable to that of instruments along with controls. However it must be reduced, as down time might mean complete loss of information. To safeguard portions of the data system requiring down time, some instruments can be tied into the system to back up the portions out of service.

Accordingly, engineering circuits being incorporated in data-handling equipment today tend to become simpler and to utilize fewer and more reliable components. These, requiring only periodic maintenance and minor repairs, should relieve the system of the need for stand-by instrumentation.

Automatic Logging to Cut Costs (*Continued from page 47*)

sign accuracy of the digitizer is at least equal to that of the input devices.

In some instances manufacturers have made special modifications to standard sensing and transducing devices in order to increase their accuracy and/or resolution.

The manufacturer of the polyphase watthour meter measuring generator output and station use power has provided special modifications to these meters to increase their resolving power to the nearest 0.1 Mwhr and 0.01 Mwhr, respectively, and to permit transmission of pulses representing suitable increments of metered energy.

The fluid flow meter manufacturer has made similar alterations to provide pulses giving a uniform resolution to the nearest 1,000 lb of metered fluid. The turbine manufacturers are providing special potentiometer outputs to indicate control valve servo or camshaft position to 0.1%.

Special procedures are being followed in an attempt to secure accurate overall calibration of the generator output metering, including current and potential transformer correction factors. Similarly, major flow elements are being laboratory calibrated or calibrated during economy tests of the units.

In spite of the above and other similar special measures for increasing accuracy and resolution of inputs to the logger it is realized that the accuracy of individually logged items will be considerably less than that obtained during precision tests utilizing dead weight gauges, mercury manometers, calibrated test thermocouples, etc.

It is however, expected that the automatic recording and processing of the data obtained will make possible, for example, studies in which the average errors for a large number of hours of operation at a given load will be very small.

Moreover, because many of the studies will be of specific losses under various types of operation, the resultant accuracy in terms of effect of these losses on turbine or station heat rate should be reasonably high. Thus these studies should provide guides to improved thermal efficiency for these units.

GE Lamp Research Center Dedicated

A multi-million-dollar Lamp Research Center of General Electric Co's Lamp Division at Nela Park, Cleveland, was dedicated Dec. 11. Its purpose is the discovery of new knowledge about the nature and effects of light and its production.

Carl L. Olson, manager of the research facility, said it was built to house an organization of research people who will not be bound by current thinking as regards the source, form, fabrication, operation, and application of light.

The Center houses three research and engineering laboratories:

1. Lamp Research Laboratory (John S. Saby, manager) is involved chiefly in scientific investigation into chemical and physical processes which give off light. The laboratory team covers the field of materials important to the lamp business.

2. Lamp Engineering Research Laboratory (D. E. Elmendorf, manager) is concerned with the interpretation of scientific research findings and translating them into sound engineering practices. The lab is a connecting link between pure science and the practical considerations involved in producing a new product.

3. Radiant Energy Effects Laboratory (Sylvester K. Guth, manager) is engaged in investigation of the effects of light chiefly on man, also on plants and animals. Its objective is to obtain a better understanding of how and why people see better with improved lighting.

This Lamp Research Center has 112,000 sq ft of research area. The three-story building is T-shaped, includes 50 labs. A typical individual laboratory is 20x30 ft.

Electric service for the typical individual laboratory includes 100-amp, 208-v, 3-phase power controlled by circuit breakers located in the corridors for easy access in case of emergency. Lighting in individual labs is provided by six fluorescent or incandescent fixtures. Light levels generally are in excess of 100 ft-c. Office lighting is furnished by a 12x12-ft fluorescent fixture, providing a level of 100-120 ft-c.

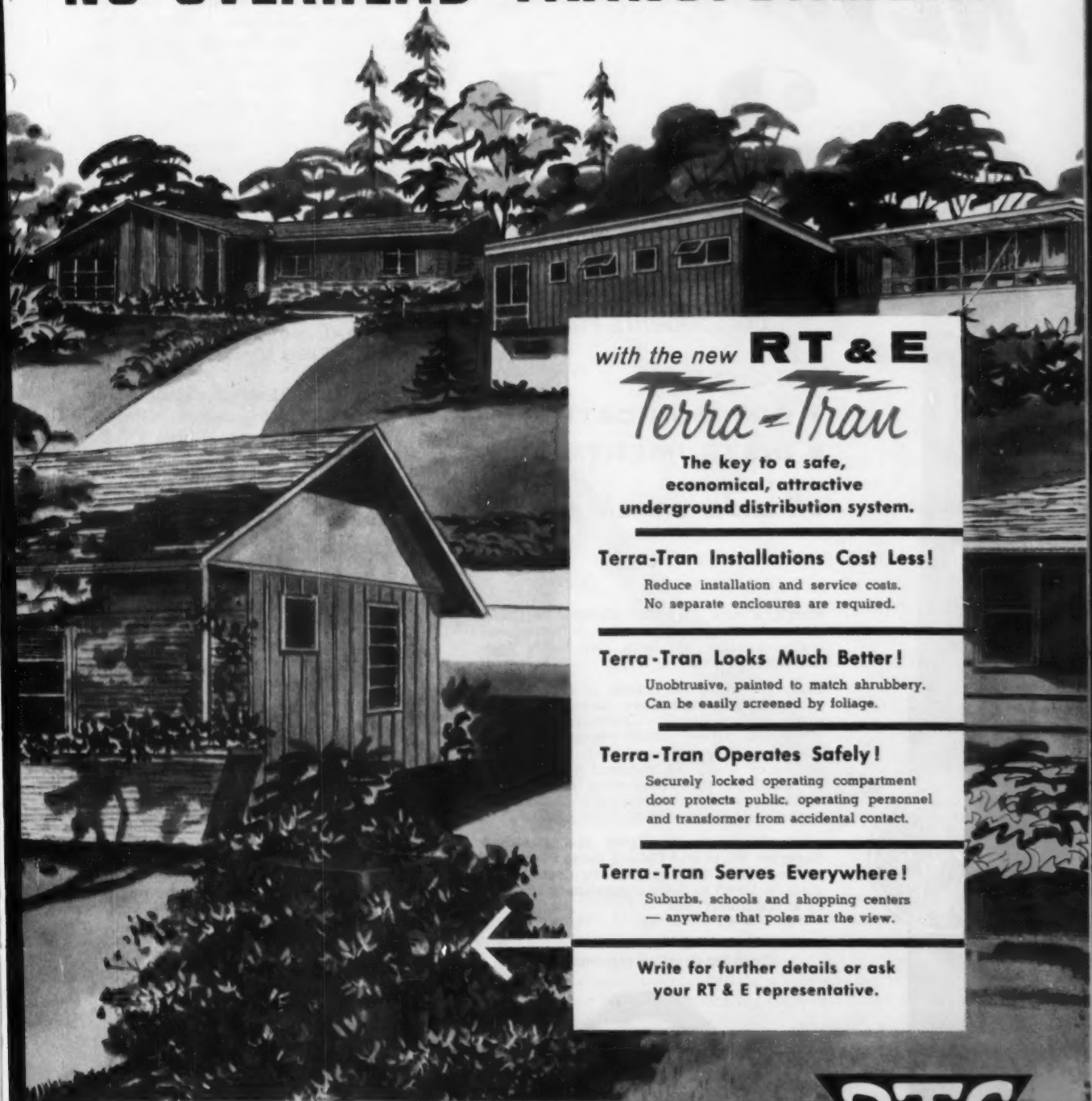
Milliken Operations Logged at Power Exhibition

Simultaneous logging of generating station operations on a local recorder and on a remote monitor is reportedly the first live demonstration of generating station performance exhibited. It was one of the highlights for electric utility personnel at the 23rd National Exposition of Power and Mechanical Engineering in New York early this month. (EW, Dec. 1, p 46)

The picture shows W. R. Wise, superintendent of Milliken Station, New York State Electric & Gas Co, and W. Greacen, III, chief mechani-

(*Continued on page* 132)

NO POLES NO EXPOSED LINES
NO OVERHEAD TRANSFORMERS



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Control circuits can consist of any number of individual conductors, pairs or groups under the unit jacket. Communication circuits of a critical nature requiring special shielding may be combined with pairs, triples or quads of standard construction. In addition, instrumentation and/or low voltage power circuits can also be included in the basic construction.

Like all plastic insulated and sheathed Superior Wires and Cables, these new composite cables are quality-engineered and manufactured to deliver maximum efficiency at minimum cost.

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SUPERIOR CABLE CORPORATION

Hickory, North Carolina

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Milliken Operations

(*Continued from page* 130)

cal engineer of the utility, monitoring station operations at the Exposition. Data was transmitted by telephone lines from the generating station near Ithaca, N. Y.

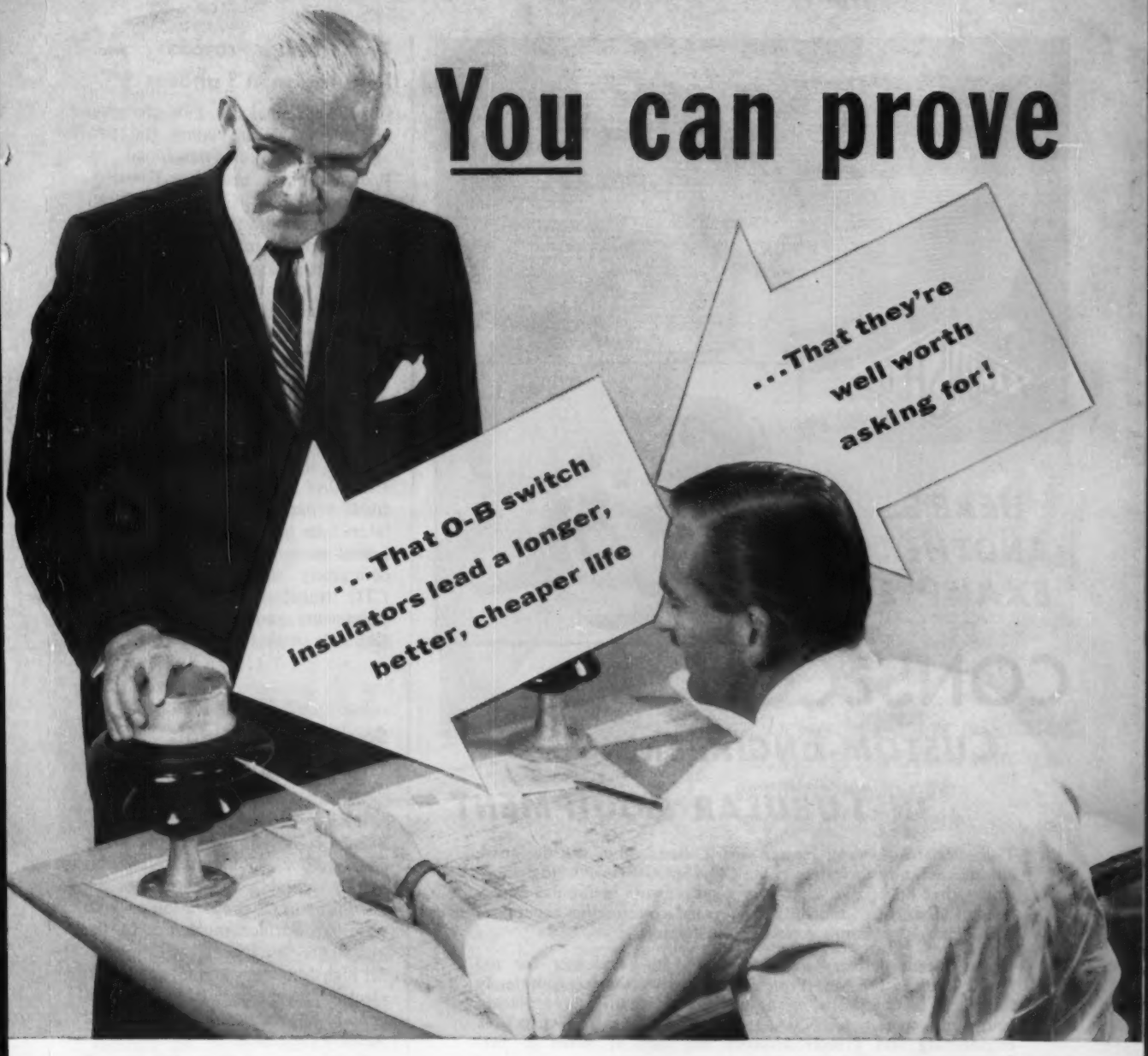
The information system at the power station is set up to measure continuously 282 variables such as temperatures of bearings, burner fuel pipe and circulating water. Off-normal measurements are printed out when they occur. In addition, the equipment logs hourly and tape punches 66 items of performance, such as flows, pressures, temperatures, and powers, of interest to the Results Department. This Metrotype information system is a product of Bailey Meter Co, Cleveland, Ohio.

Additional Exhibition items of interest to utility folks follow.

- Silcoflex (silicon) insulation for coil windings in frames 445 U and larger, and Poxeal (epoxy resin) insulation for smaller frame sizes were exhibited by Allis-Chalmers Mfg Co, Milwaukee, Wis.
- A 60-ft dual-gage Cupro Nickel, 30%-702 tube with a U-bend for heat exchanger service, also a prototype of an extruded nuclear fuel element (uranium alloy core encased in zirconium alloy) for a power reactor, were featured by American Brass Co, Waterbury, Conn.
- Class F materials will be used for insulation in oil-immersed Class A transformers and dry-type Class B lighting transformers manufactured by Marcus Transformer Co, Rahway, N. J.
- An auto-pneumatic Microflo Pulsafeeder, for treating make-up water, is a controlled volume pump for metering fluids at small flow rates and at pressures up to 2,000 psig. Capacities of 1040 and 2300 ML per hr are the most recent designs made by Lapp Insulator Co, Leroy, N. Y.
- Permaglas smokestacks are glass-protected stacks inside and outside for protection against corrosive flue gases. Installations have been made by electric utilities in the eastern U. S. They have been furnished by A. O. Smith Corp, Milwaukee, Wis.

(*More Manufacturers News, p* 134)

You can prove



Standards *don't say* all switch insulators are alike -- neither does your experience. Some live longer than others, and give "better mileage" on your investment. Some have a history of little or no trouble; little or no maintenance expense.

Which ones? Look at your own records.

In your own files -- maybe your own handwriting -- and stated in your own terms, are facts that should contain an interesting story. You can see what insulators were installed, when, and the subsequent replacement record, and if your findings are typical, O-B will show a distinct advantage. Remember, this isn't *our* story, it's *yours!*

Switch manufacturers will gladly supply any make of insulator you choose. You need only *make that preference known.* By the simple act of asking for O-B insulators on your new switches, you will continue getting a bonus in performance that your own operating facts can prove is true.

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Canadian Ohio Brass Co., Ltd., Niagara Falls, Ont.

Ohio Brass

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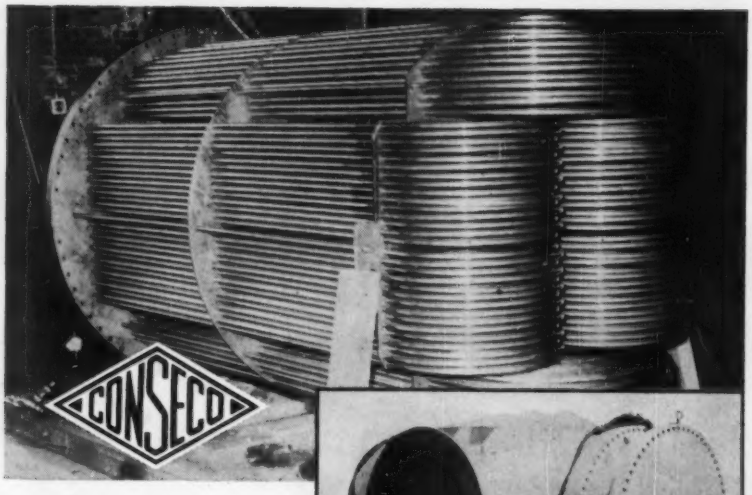

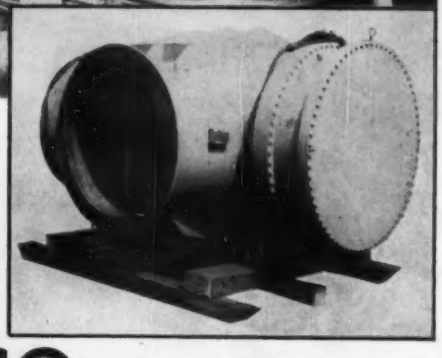

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Transformer Provides Regulation in 3 phases

A 3-phase load tap changing transformer with claims for two "firsts" has been developed by Pennsylvania Transformer Division, McGraw-Edison Co, Canonsburg, Pa. It provides individually controlled voltage regulation for each phase. It also permits safe inspection and maintenance of the LTC contacts and drive mechanism while the transformer remains energized and continues to deliver uninterrupted 3-phase power.

The unit, called the "Pennsylvania Phase-Isolated Load Tap Changing Transformer", is said to provide the user all the flexibility and other advantages of regulation from separate single-phase regulators. In addition, it has the inherent economical advantages of a completely self-contained 3-phase LTC transformer, including unit purchasing and one-piece installation on a single foundation.

Sound Welds Metals, Thermistors Protect Motor

Westinghouse Electric Corp's materials engineering department, Pittsburgh, is developing an ultrasonic seam welder which makes dissimilar metals weldable and eliminates the need for surface preparation prior to welding. Surface molecules of the metals are "stirred up" with powerful high-frequency sound waves. No electric current or outside source of heat is applied, as in conventional welding processes.

Solid-state devices which will serve as small, contactless thermal switches have been developed by engineers in Westinghouse Electric Corp's materials engineering laboratories, Pittsburgh. Called "positive temperature coefficient thermistors", they are particularly applicable for over-temperature protection for hermetic motors in large air conditioning and refrigerating systems.

Initial shipment of the thermistors will be sent to the Westinghouse Motor Department, Buffalo, N. Y. There, they will be used in conjunction with the new "Guardistor" motor protection system. The thermistors will be installed directly in

motor windings to operate a small external relay which de-energizes the motor or gives a signal when overheating occurs.

Westinghouse plans to market hermetic motors with the new protective system shortly.

I-T-E Awarded Indian Point Bus, Switchgear Contract

I-T-E Circuit Breaker Co, Philadelphia, has been awarded the contract to supply isolated-phase bus and low-voltage switchgear for Consolidated Edison's 275-Mw Indian Point nuclear generating station. The station is scheduled to go critical in 1960.

Low-voltage switchgear will be installed in station load centers to protect and control station service and auxiliary circuits. It will be shipped by Fall, 1959, from I-T-E's Switchgear Division, Philadelphia.

The bus system will be designed and fabricated by I-T-E's Greensburg Division, Greensburg, Pa., and shipped in 1960. It is comprised of 1250 ft of 3-ft-dia electrical conductor, carrying 16.5 kv from the plant's one 275-Mw generator to two 138-kv step-up transformers. An additional 384 ft of 14.4-kv bus will be installed to carry station service and auxiliary power.

MANUFACTURERS BRIEFS

RT&E Corp, manufacturer of distribution transformers, broke ground recently for its new research and engineering laboratory to be located adjacent to the main plant at Waukesha, Wisc.

Cochran Foil Corp, Louisville, Ky., wholly-owned subsidiary of The Anaconda Co, New York, N. Y., announced $2 million expansion project will begin next Spring. Most of the expenditures will be for two foil-rolling mills and an addition to office and factory facilities.

Narda Ultrasonics Corp, Westbury, Long Island, N. Y. will mass-produce the Series 5000 SonBlaster, 500-w, 40-kc, 10-gal cleaning systems for industrial use.

LOS ANGELES GOES UNDERGROUND TO LOWER OVERHEAD

Underground power distributing station assigns critical switchgear control job to long-life C & D PlastiCal® batteries

First completely underground station in Los Angeles, the new Civic Center Underground Electric Distributing Station is located right in the heart of the busy downtown area.

Only the air intake and outlet openings, an equipment hatch, and personnel entrances are visible on the surface. The underground facility is in harmony architecturally with the modern surrounding Civic Center buildings.

Designed for maximum efficiency, reliability, and low operating cost, this remotely-controlled sub-surface station will serve the increasing power demands of the civic center area. The critical job of switchgear control—as well as emergency lighting for the station and apparatus—is assigned to advanced-design C & D PlastiCal® lead-calcium grid control batteries.

In an unattended station such as this, where absolute dependability and minimum maintenance are demanded, C & D PlastiCal batteries are particularly suited for the job. *Specifically engineered* for control, PlastiCals provide a high instantaneous surge of power. Built to last 25 years in full float service, the batteries never require watering more than once a year and make frequent equalizing charging obsolete.

Full details on these 25-year life C & D PlastiCal and long-life PlastiCell batteries—pioneer batteries in the clear plastic jars—may be obtained from your equipment supplier or nearest C & D representative. Or, send for new Bulletins CP-539 and CP-540.

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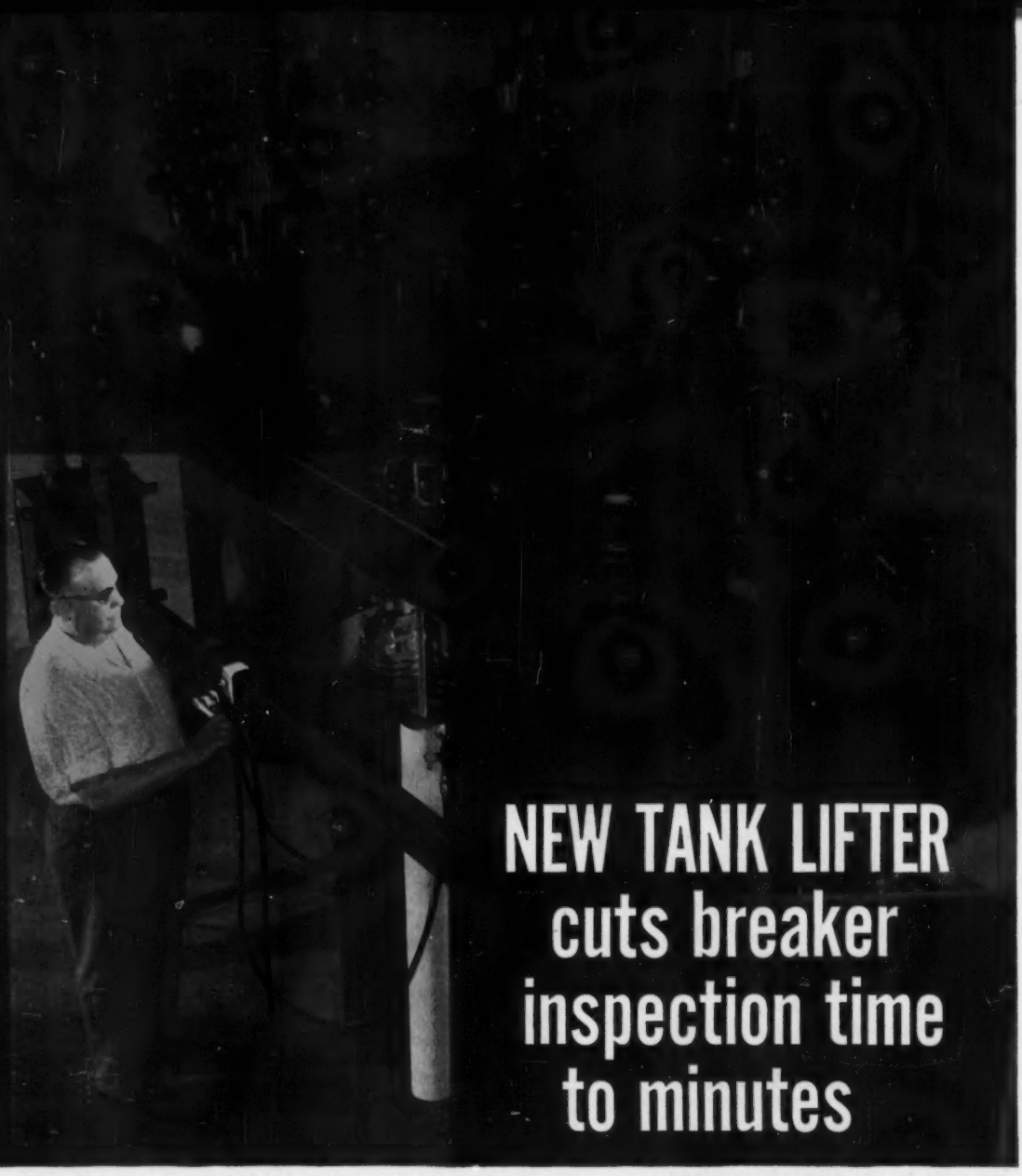
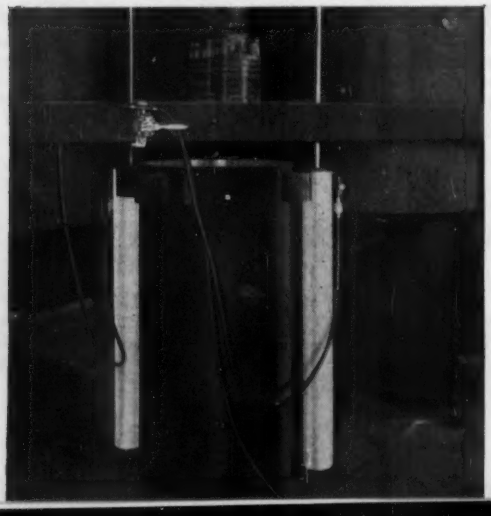


NEW TANK LIFTER cuts breaker inspection time to minutes

Tank Lifter control is connected directly to the tank of the breaker's air supply through flexible, high-strength rubber tubing. Lightweight control, tubing and cylinders can be easily stored when not in use or kept on the maintenance crew's truck.



The time-consuming labor of lowering and lifting breaker tanks for inspection and maintenance can be practically eliminated with the new Westinghouse Pneumatic Tank Lifter. Operated from the breaker mechanism's air supply, this device will, in approximately two minutes, raise or lower a full tank of oil. Grids and contacts can be inspected with minimum delay.

The pair of pneumatic cylinders can be easily moved from tank to tank. A single operating valve and a built-in, self-leveling device assure simple, trouble-free operation with a minimum of effort.

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Rates and Regulation

Utilities Hail 'Memphis' Reversal

The U. S. Supreme Court's reversal of the "Memphis decision" Dec. 8 gave a dramatic boost to the natural gas transmission companies. Its effect on the rest of the utility industry was less clear, but a check with electric utility executives, rate experts, security analysts, and the Federal Power Commission indicates that it will be salutary. Here's a summary of reactions:

Expectation that the new ruling will speed expansion of the gas business.

Doubt that natural gas prices will rise much faster in the long run than they are rising already, although short-range hikes are seen.

Belief that a dangerous regulatory precedent has been struck down. The idea embodied in the "Memphis decision" that unanimous customer consent be necessary before rate hikes was roundly denounced as "ridiculous" and "impossible."

Before the controversial Memphis decision by a circuit court, this procedure could be followed by a pipeline company in raising rates: The firm could file the hike with the Federal Power Commission, which suspended it for six months. If during that period FPC took no further action, the rate increase automatically went into effect. After that, FPC could revoke the increase if it saw fit, but this was never done in practice.

In the "Memphis decision" the circuit court held, in effect, that a pipeline firm could not ask FPC for increased rates without prior approval of its customers. Only alternative was to request a formal FPC hearing and wait two or three years for its outcome—while continuing to charge the lower rates.

In striking down this ruling, the Supreme Court reopened the short-cut procedure. In so holding, the court said: "Business reality demands that natural gas companies should not be precluded by law from increasing the prices of their products whenever that is the economically necessary means of keeping intake and outgo of their revenues in proper balance. . . ."

One immediate effect of the Supreme Court's ruling will be to cause transmission companies to go ahead with expansion curtailed after the Memphis decision, bringing more gas to compete with kwhrs and furnish off-peak boiler fuel.

Spokesmen for a leading investment banking firm closely associated with the gas industry expected no increase in tempo of filings for rate hikes by the transmission companies, but did expect a rash of decisions by FPC on those increases already filed. The president of one combination utility saw a short range increase in the price his company would have to pay for gas. He added, however, "The long range effect of the Memphis decision, had it been allowed to stand, would have been to make the distributing utilities and the consumers pay higher prices—not lower. The transmission companies couldn't have operated under that set-up."

The FPC does not believe the Supreme Court's decision will have any practical effect on electric company operations or procedure before the commission. The principles would apply to an electric company engaged in the interstate movement of power if its contract allowed something other than a fixed and final rate. But the decision hasn't caused any excitement about electric power rates, since most electric contracts call for specific amounts.

General appraisal of the impact of the Supreme Court's action was summed up by a security analyst who said: "Its effect is to return to a healthy *status quo*. If the Supreme Court had not reversed the Memphis ruling, that would have had a profound and unhealthy impact."

Employees Want Information on Public Power

Employee Information

Utility employees want more information about the problems of the industry, according to a 20-state survey made by Central Surveys, Inc, for the electric companies' Public Information Program. The check, which covered 3,865 employees of 24 electric utilities dotted about the U. S., showed that although they are better informed than the general public, utility employees could use more information. Although they are loyal to the investor-owned utilities, many are either uninformed or misinformed when it comes to several basic facts.

The table opposite shows some of the strengths and weaknesses of utilities' employee information programs reported by William M. Longman, of Central Surveys, at the PIP Workshop Conference held recently in Minneapolis. Roughly three out of five employees thought that power companies have taken the lead in developing nuclear power; and about three out of four could name at least one company—not necessarily their own—which is working on an atomic project. But the only advantage of atomic power that many employees could cite was that it might be cheaper than power from conventional sources. Only 29% explained that the atom will provide another source of fuel as conventional fuels become less plentiful. Also, fully one-third of all employees thought atomic power would be cheaper than conventional within five years.

About 59% of employees had some idea of what "preference" is, but this includes only 45% who believe it applies to REA cooperatives, and only 25% who think it applies to municipals. Among the 17% who have an altogether wrong impression of preference are included 7% who think power companies have first chance.

Knowledge of REA cooperatives is meager. Only 35% of the employees knew that REA co-ops pay no federal income tax. As for local taxes, 55% were aware of some different treatment than companies receive. This includes 29% who

What Utility Employees Think about...

A-Plants

Q. Who does most to develop A-power?

A. Power companies 59%
The government 5%
Companies & gov't 23%
Don't know 13%

Q. What will be the advantage of atomic power?

Cheaper 47%
Save fuel resources 29%
Other advantages 32%
Don't know 21%

Q. Will cost of A-power be higher or lower than other sources in five years?

Higher 34%
Lower 33%
Same 16%
Don't know 17%

Preference

Q. What is "preference"?

A. Know what it is 59%
Wrong impression 17%
Don't know 24%

Q. Who benefits from preference?

REA Coops 45%
Municipals 25%
Power companies 7%

REA Coops

Q. Which statements about REA Coops are true?

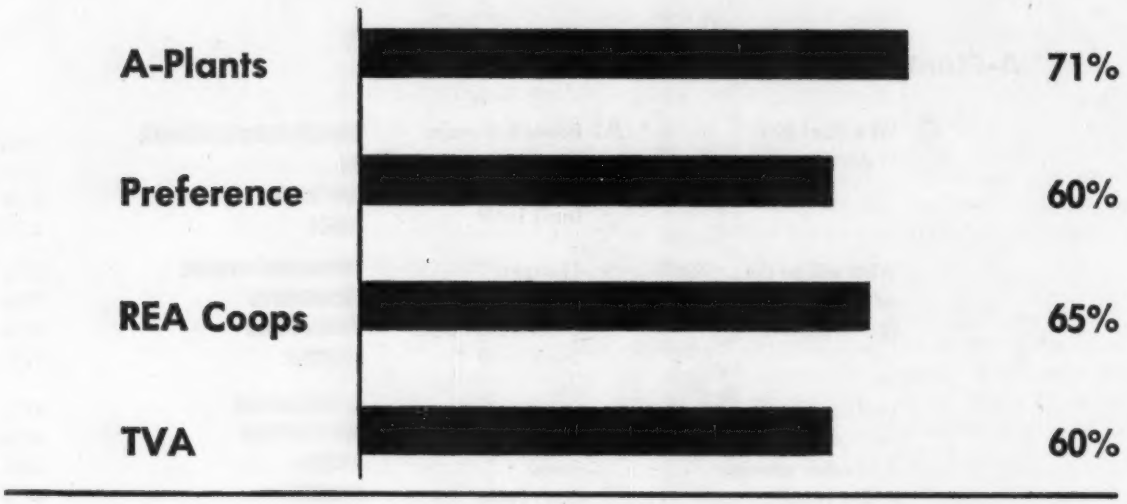
A. Pay no federal income tax 35%
Pay less in local taxes 55%
Can borrow money at 2% 41%
Have many non-farm customers 38%

TVA

Q. Which statements about TVA are true?

A. Pays no federal income tax 62%
Pays less in local taxes 65%
Pays no interest on its loans 26%
Has more steam than hydro 32%

How Many Employees Want More Information about...



said co-ops pay no local taxes and 26% who said they pay some, but less than the amount paid by investor-owned electric companies. Only 38% of the employees realized that at least half of the co-ops' customers are not farmers.

Knowledge of TVA is spotty. Slightly more than 60% knew that TVA pays no federal income tax and pays less "local taxes" than investor-owned companies do. There is much less knowledge regarding the failure of TVA to pay interest on the money it owes the U. S. Treasury, and on the point that the Authority is now primarily a steam rather than a hydroelectric system.

Last winter when the survey was taken, only one in every four employees had heard of the TVA revenue bond proposal. Many of those who had heard of it felt that its effect would be to restrict rather than to aid TVA. A common misconception was that the revenue bonds would be for the purpose of replacing TVA's present obligation to the Treasury, rather than to raise new money.

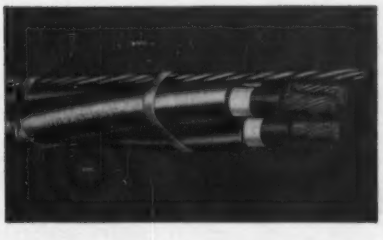
Most companies were surprised at their employees' lack of knowledge of the revenue bond issue, when they were confronted with the results of the survey. Eight out of 18 said their employees had shown themselves to be less well informed about REA co-ops than they had expected. On the other subjects, most companies said their employees were about as well informed as they had expected, but in general very few companies were pleasantly surprised by the amount of knowledge their employees displayed.

Most encouraging result of the survey is shown on the chart above. Most employees want to become better informed about these subjects. Atomic energy and atomic power plants head the list; but proportions of 60% and higher express themselves as wanting more information on REA co-ops, TVA, and preference.

Indications are they will get their wish. Longman reported that 15 of 19 companies said they have stepped up their information activities in one way or another, while three more had new projects in the planning stage. The employee magazine is apparently the most popular way. Much use has also been made of special booklets, such as PIP's *River of Green* and *The Castaways;* and some are giving or planning special courses on the economics of the industry. Edison Electric Institute's *The American Economic System* was also mentioned, and a few companies issue supervisory bulletins and special letters to individual employees.

IN PLANTS, where mazes of pipes and other underground installations make the placement of ducts or buried cable costly or difficult, aerial cable solves the problem.

End black-outs—with Anaconda Aerial Cable! It weathers the weather!



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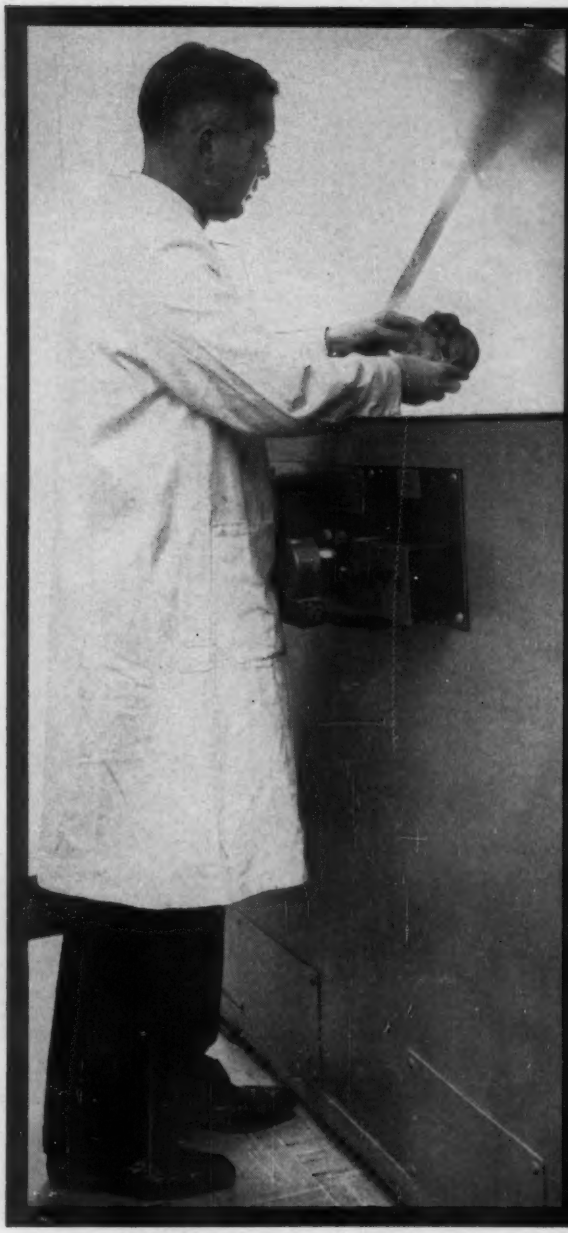

At left, Tom Daley, supervising engineer, is inspecting a sample frame in a laboratory salt spray chamber where heat, humidity and salt fog give finishes a punishing test.

Frank Kuhn, engineering section manager, at right, checks an accelerated humidity test on the new single-metal-system register for corrosion...and investigates compatibility of parts.

From Plowback of Earnings

A Meter 2 to 5 Times More Corrosion Resistant

FULL MEASURE FROM WESTINGHOUSE METER RESEARCH

Development of new metal finishes and use of a single-metal-system register design have given Westinghouse single-phase meters from 2 to 5 times more corrosion resistance than conventional units.

The elimination of dissimilar metals and use of a compatible finish system on all components in the register removes the possibility of electrochemical corrosion occurring under extreme environmental conditions.

Frame corrosion has been minimized by use of a new thermosetting epoxy ester enamel, which Westinghouse helped develop.

Not only were all the metals used in the meter tested *individually* for corrosion resistance, but any chemical interaction of components was thoroughly investigated. For instance, Westinghouse coil insulation, under heavy overload, *does not* produce fumes that will accelerate corrosion or condense on the working parts of the meter and glass cover.

To learn how you can reduce the cost of metering on your system, call your Westinghouse sales engineer. Or, write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa. J-40514

YOU CAN BE SURE... IF IT'S Westinghouse

FULL

MEASURE

FROM

WESTINGHOUSE

METER

RESEARCH

New electronic transistorized oscillator obsoletes mechanical techniques

A new era of impulse metering

. . . without maintenance, friction load or delicate adjustments

Jeff Snyder, Engineering Section Manager, demonstrates a major improvement in impulse metering for electrical load control. Both friction load and fragile contact fingers have been eliminated. It's a big step forward in trouble-free operation of demand recorders and control equipment!

The Westinghouse Type-CV impulse device can be readily added to any standard watthour meter for generating impulses of specific watthour or varhour value. This electronic device eliminates the delicate adjustment and frequent maintenance associated with mechanical units.

Higher impulse rates and use of smaller impulse values are possible with the CV oscillator . . . with resultant increased accuracy. These impulses can be totalized, used for remote control, to sound demand alarms or registered on demand recorders.

To learn how to get Full Measure in your impulse metering, call your Westinghouse salesman or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. J-40513

YOU CAN BE SURE...IF IT'S

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Here Are Some Cold-Weather Tips

Portable Slab Brooder Warms Chicks

JOE N. HOWARD, Agricultural Engineer, Duke Power Co, Greensboro, N. C.

A portable slab brooder that provides sufficient heat under chicks during all types of weather is helping Duke Power Co's customer farm better electrically. After nearly two years, the users have expressed pleasure with the brooder's operating costs, the livability and rate of growth of chicks, and over-all dependability of the brooder.

The brooder slab consists of two pieces of tempered masonite cemented together to render it waterproof. A resistance element is coiled between the pieces of masonite. Its wattage is determined by the capacity of the brooder. This masonite pad is supported on a wooden frame and is thermostatically controlled.

Supported on metal legs over the pad is a hover, consisting of a piece of insulation board with a surrounding plastic curtain, extending to within an inch of the pad. A 7½-w attraction lamp is mounted just under the hoover and a pilot lamp on top indicates when the pad is energized.

Brooders, manufactured by Radiant Products, Inc, Monroe, N. C., are available in 250,500, and a special request 1,000-chick, capacities.

These brooders are being used on farms with only a few hundred pullets being brooded for replacement of the laying flocks, and on farms with from a few thousand to over 200,000 broilers brooded annually.

Operating costs have varied from less than ⅛ to ¼ kwhr per chick.

Heating Cables Solve Snow Problem

Here's an efficient, cheap, and backache-free way to keep driveways clear of snow. Pictured is a driveway immediately after snow had stopped falling. Not only are the wheel tracks free of snow, but also the snow blanket between the tracks and for a distance of 2 to 2½ ft on either side has been lowered about 50%.

It was done with approximately 1,200 ft of General Electric lead-sheathed, Flamenal jacketed heating cable, laid to full width in front of the garage doors and tapering to wheel tracks 1½-ft wide for the rest of the driveway. The cable was laid in 12 different circuits on 4-in. centers, giving a heating capacity of 30-w per sq ft.

Separate circuits were used as it was figured that, though this type of installation had a slightly higher initial cost, it would offer savings on power.

If the snow is piled on one section of the driveway others can be shut off. If there is a light snow where it is not necessary to clear off wheel tracks, the apron to the garage doors can be kept clear and dry.

The cable installation was also made slightly wider at each end of the wheel tracks to allow for the curve of car wheels when entering or leaving the driveway.

Keeping the apron and wheel tracks clear for the 70-ft driveway used approximately 12 kwhr for each hour of operation of the entire system. Assuming that the charge per kwhr would be approximately 2½¢ this "snow shoveling" job cost only 30¢ an hour—much less than it would have cost to pay a local live snow shoveler.

Dorsey Promoted at VEPCO

B. J. Dorsey has been elected vice president of the northern division of Virginia Electric & Power Co, effective January 1, 1959. He will succeed John W. Howard who is retiring.

Prior to joining Vepco in 1927 as a salesman at South Boston, Va., he served in the engineering department of Commonwealth Edison Co. From the position of salesman he advanced in various supervisory positions including local manager at Altavista, Ronceverte, W. Va., and Charlottesville; assistant district manager of the eastern division; manager, electric department, Newport News; and district manager at Newport News, Charlottesville and Norfolk. He is presently district manager at Norfolk.

He studied engineering at Bliss Electrical School, and took courses in engineering and utility management at the Chicago Central Station Institute, and a management development course at the Georgia Institute of Technology. He also attended Armour Institute in Chicago.

Goldberg Appointed Chief Engineer

Public Service Co of Indiana has appointed Harold Goldberg to be chief engineer. He will be responsible for electrical design and construction for the utility's major electric facilities and installations.

A 35-yr veteran of the company, Goldberg joined it in 1923. He served in various engineering and construction capacities until 1948 when he was promoted to superintendent of plant construction.

In 1951 he was promoted to superintendent of general construction and served in that capacity until his appointment as chief engineer.

A graduate of Purdue University with a degree in electrical engineering, he is a member of the American Institute of Electrical Engineers and a member of Sigma Alpha Mu fraternity.

Heath Named Head of Buffalo Forge

William R. Heath is the new president of Buffalo Forge Co. He replaces Edgar F. Wendt who is retiring.

Heath has been with Buffalo Forge for 36 years, starting in engineering. He was made chief engineer in 1948, director of manufacturing in 1951, a vice president in 1953, and executive vice president in 1955.

A graduate of Cornell University in 1922 with a degree in mechanical engineering, he has worked on blower installations all over the continent. He is responsible for designing fans for the Lincoln Tunnel in New York and the Boston Tunnel. He is a past president of the Western New York Chapter of the American Society of Heating and Air Conditioning Engineers.

Wendt will continue as a director of the company. He has been with Buffalo Forge for 47 years and has served as its president for 29.

Slam it closed "blind"...

this cutout never misses!

The lineman doesn't have to steer the fuse tube into the contact of S&C's XS Cutout

If the lineman closes into a *fault* and misses—where is the lineman?

If he closes into a *load* and misses—what can the lineman do?

Even an experienced lineman shouldn't be expected to steer a cutout closed; for safety's sake, he must look away.

For positive steering when closing, the fuse tube of S&C's XS Cutout is controlled in four ways:

(1) The tube trunnion is thrust firmly forward into pockets in the hinge by the contact springs.

(2) The tube trunnion is simultaneously stabilized by the hinge's inner surfaces acting on the vertical faces of the trunnion casting.

(3) At the same time, guide edges of the hinge steady the corresponding edges of the lifting eye in the tube trunnion casting.

(4) LOADBUSTER® attachment hooks act as guides to steer the fuse tube as it "wipes in" and seats positively.

These four elements provide certain closing action, even when slammed home blind. And on dark and windy nights, closing is a sure thing, without hang-ups or damage.

For full information about the XS Cutout and its use with LOADBUSTER for load switching, write for Bulletin 511 to S&C Electric Company, 4421 Ravenswood Ave., Chicago 40, Ill. In Canada: S&C Electric Canada, Ltd., 8 Vansco Road. Toronto 14, Ont.

S&C

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Metalclad Switchgear • Fuse Links • Power Fuses

Seattle City Light Co has made **Rhodes V. Spencer** power-operations engineer succeeding **William J. Olson,** who retired after 41 years with the utility.

Henry H. Kerr has become associated with Commonwealth Associates Inc, Jackson, Michigan as a consulting engineer.

Edison Electric Institute has presented a unique award to the Detroit Edison Co, and its president, **Walker L. Cisler** for their outstanding contribution to the advancement and development of the American electric power industry.

These staff changes have been made at Boston Edison: **Harold E. Stickle** has been made head of a newly established technical section in Boston Edison's production department and also head of the company's mechanical technical division. **Milo O. Bolton** has been appointed general station plant construction engineer, and **Thomas E. Nolan** has been named chief engineer of steam stations in the steam operating section of the production department. In the steam and electric operations organization **Gregory J. Samoylenko** becomes maintenance engineer, reporting to the superintendent of production.

William E. Sturm has been named director of general services West Penn Power Co. **John F. McQuillin** will succeed him as Eastern division manager.

Arthur D. Church of Pacific Gas & Electric Co will retire as manager of the San Joaquin Division.

L. A. Wiedman, northern division manager, of the Oklahoma Gas & Electric Co has retired after 38 years with the company. **William G. Frass** will replace him as division manager. **Elmer Dixon** has been named district manager and **Larry Slief** division sales supervisor.

C. D. Demsey has been made division plant superintendent of Washington Water Power Co's Palouse division. **R. C. Smolinski** will replace Demsey in his former position of assistant division plant superintendent.

William H. Draper, president of the Mexico Light & Power Co, Mexico City has been appointed by President Eisenhower to head a special nine-man committee to study and plan U.S. military spending and tactics abroad. General Draper (reserve, retired) was a key figure in the Berlin airlift operation.

R. Clyde Gerber, Jr. has been named chief project engineer for the Hallam Nuclear Power Facility of the Consumers Public Power District of Nebraska. **Frank E. Parkins,** 66, has retired as its District Sales Chief.

Robert R. Hogarth, assistant chief engineer, has retired from the Black Hills Power & Light Co after 27 years of service.

Irvin E. Dischinger, wage and salary coordinator for Ohio Edison Co, has retired. He was succeeded by **D. J. List,** former personnel relations analyst.

Pacific Gas & Electric Co's home economics director, **Mrs. Marguerite Fenner,** has been appointed by Secretary of Agriculture Ezra Taft Benson to the Agriculture Department's Home Economics Research Advisory Committee.

J. Karl Meyer has been appointed area development representative for the Potomac Edison System.

Duke Power Co has appointed **G. G. Mattison** manager of operational engineering; and **C. E. Watkins** as manager of construction.

Consumers Power Co has promoted **Hugh J. McKernan** to assistant electric production supervisor at the

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Two opportunities currently exist on the editorial staff of Electrical World.

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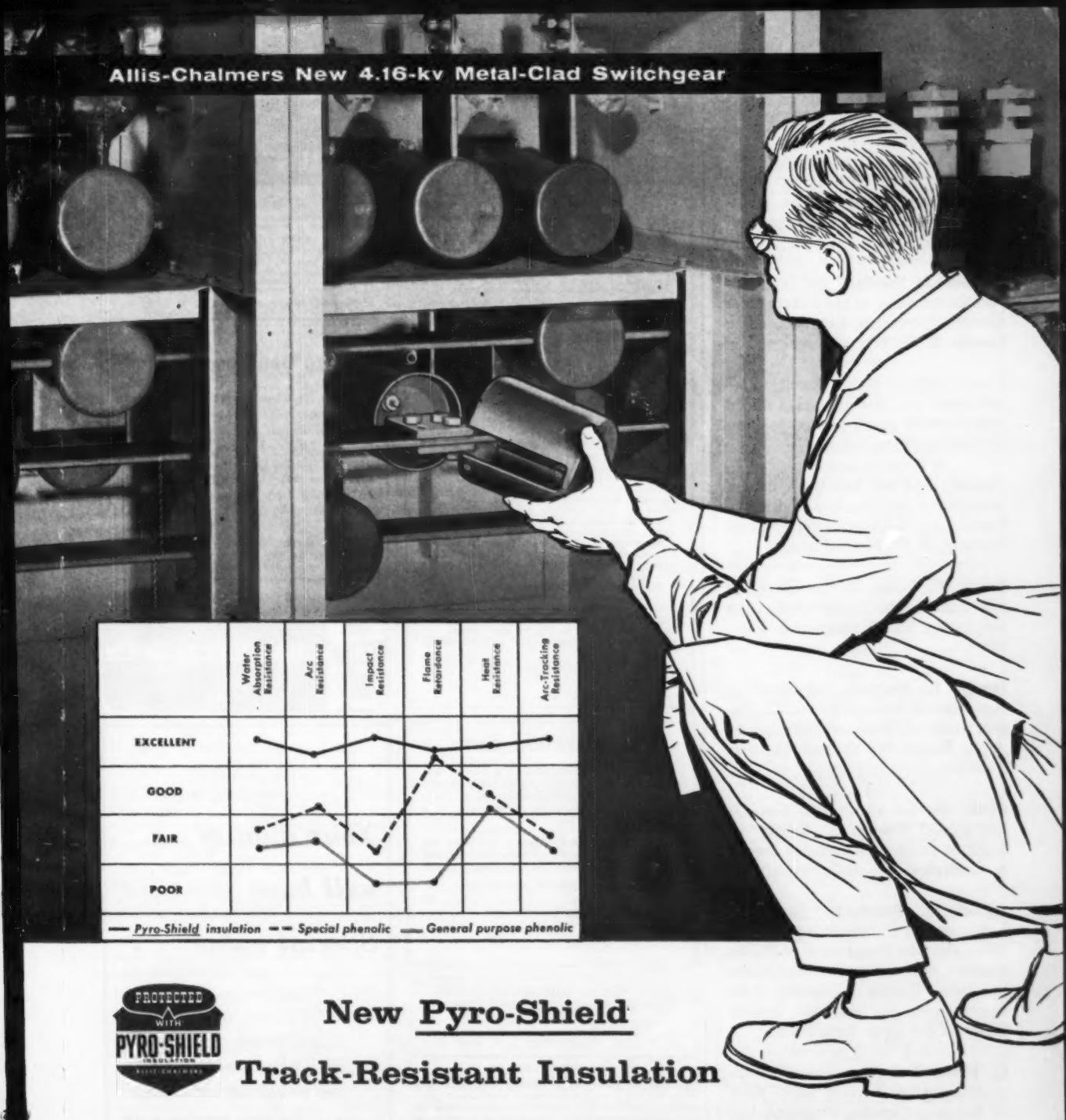

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New Pyro-Shield Track-Resistant Insulation

Track-resistant *Pyro-Shield* insulation is a polyester glass base material now used in Allis-Chalmers coordinated system of switchgear insulation.

One molding connects primary disconnects to bus bars to provide uniform insulation and reduce the number of insulation components.

In addition to being track resistant, *Pyro-Shield* insulation has high impact strength, which eliminates risk of damage from short-circuit stress and assures low moisture absorption.

Other advantages are: high flame retardance; long life — even at high temperatures; resistance to chemical fumes; and bus joint construction that eliminates need for skilled taping techniques.

Get details on this new insulation and other Allis-Chalmers switchgear features, including the low 72-inch silhouette and new *Shelter-Clad* design. Contact your nearby Allis-Chalmers office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

For Progress in Switchgear

ALLIS-CHALMERS

Pyro-Shield and Shelter-Clad are Allis-Chalmers trademarks.

A-5862

General Office in Jackson. **Harold B. Pence** will succeed him as superintendent at Saginaw River generating station.

After 40 years with Long Island Lighting Co **Crosby Brezee,** assistant to the vice president in charge of sales, is retiring.

Orlando L. Sarsfield has been appointed treasurer of the American & Foreign Power Co, Inc, succeeding **George B. Herbert** who resigned.

Lorain-Medina Rural Electric Cooperative Inc has named **Clifford Putzier** to the newly created position of Electrification Advisor.

Harold F. Carr has been named manager of the East Bay Division of Pacific Gas & Electric Co on the retirement of **W. Frank Pape.**

Frank W. Womer Sr. has retired as vice president in charge of division operations for Pennsylvania Electric Co.

Henry B. Sargent, president of American & Foreign Power Co Inc, was made an honorary member of Alpha Kappa Psi, national business fraternity.

Public Service Electric & Gas Co has named **Warren A. Knight** director of publicity succeeding **Joseph A. Gallagher,** who died November 1.

David M. Brackman has been nominated as a commissioner in the Massachusetts Department of Public Utilities. He will replace Tax Commissioner **Joseph P. Healey** who has resigned to join the Boston Edison Co's legal department.

G. Eldon Tufts, supervisor of accounting at the Danvers, Mass, plant of Sylvania Lighting Products, has been appointed president of the National Management Association.

Dr William C. White, provost and vice president of Northeastern University, and **Myron S. Wilson,** manager of engineering, electrical instruments and the instrument department of the General Electric Co, have been raised to the grade of fellows by the American Institute of Electrical Engineers.

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Submit resume showing specific experience, education, salary expected and include snapshot. All inquiries confidentially handled.

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The Meetings Calendar

JANUARY - 1959

International Home Furnishings Market — The Merchandise Mart, Chicago, Ill., Jan. 5-16.

• **Third Annual LBE National Women's Conference**—Edgewater Beach Hotel, Chicago, Ill., Jan. 8-10.

Edison Electric Institute—Industrial Power & Heating Group, Atlanta, Ga., Jan. 15-16.

Joint Edison Electric Institute Industrial Relations Committee and Personnel Practices Committee of the **Pennsylvania Electric Association**—Carlton House, Pittsburgh, Pa., Jan. 15-16.

• **Oklahoma Utilities Association**—Accounting Section Conference, Biltmore Hotel, Oklahoma City, Oklahoma, Jan. 16.

• **Pennsylvania Electric Association** — Communications Committee, Hotel Pick-Roosevelt, Pittsburgh, Pa., Jan. 22-23; System Operation Committee, Fort Stanwix Hotel, Johnston, Pa., Jan. 29-30; Structures and Hydraulics Committee, Benjamin Franklin Hotel, Philadelphia, Pa., Jan. 29-30.

• **Power & Communications Contractors Association**—14th Annual Convention, Shamrock Hilton, Houston, Texas, Jan. 25-27.

Canadian Electrical Association—Eastern Zone Section Meetings, Chateau Frontenac, Quebec, P. Q., Canada, Jan. 26-29.

• **American Society of Heating & Air-Conditioning Engineers**—14th International Heating & Air-Conditioning Exposition, Convention Hall, Philadelphia, Pa., Jan. 26-29.

Doble Clients Conference — 26th Annual Meeting, Sheraton Plaza Hotel, Boston, Mass., Jan. 26-30.

Midwest Welding Conference—5th Annual Conference sponsored by Armour Research Foundation of Illinois Institute of Technology and the Chicago section of the American Welding Society, Chemistry Building, Illinois Tech campus, Jan. 28-29.

Public Utilities Advertising Association — Regional Meeting, Timberline Lodge, Portland, Oregon, Jan. 29-30.

FEBRUARY

American Institute of Electrical Engineers—Winter General Meeting, Statler and Sheraton-McAlpin Hotels, New York City, Feb. 1-6.

• **American Society for Testing Materials**—Committee Week Meeting, Penn-Sheraton Hotel, Pittsburgh, Pa., Feb. 2-6.

Edison Electric Institute—Prime Movers Committee, Hotel Beaumont, Beaumont, Texas, Feb. 2-4; Transmission & Distribution Committee, Morrison Hotel, Chicago, Ill., Feb. 12-13; EEI-AGA Accounting Conference, Final Working Committee, Lord Baltimore Hotel, Baltimore, Md., Feb. 16-17; Electrical System & Equipment Committee, Atlanta Biltmore Hotel, Atlanta, Ga., Feb. 16-17.

Pennsylvania Electric Association—Transmission & Distribution Committee, Hotel Benjamin Franklin, Philadelphia, Pa., Feb. 5-6; Prime Movers Committee, Hotel Pick-Roosevelt, Pittsburgh, Pa., Feb. 12-13; System Planning Committee, Hotel Bellevue-Stratford, Philadelphia, Pa., Feb. 16-17; Electrical Equipment Committee, Hotel Benjamin Franklin, Philadelphia, Pa., Feb. 19-20; Relay Committee, Hotel Pick-Roosevelt, Pittsburgh, Pa., Feb. 26-27.

Missouri Valley Electrical Association—Industrial and Commercial Sales Conference, President Hotel, Kansas City, Mo., Feb. 5-6.

National Association of Purchasing Agents—Public Utilities Buyers Group Mid-Winter Meeting, Chase Hotel, St. Louis, Mo., Feb. 8-10.

National Electrical Week—February 8-14.

National Rural Electric Coop Association — Annual Meeting, Shoreham and Sheraton-Park Hotels, Washington, D. C., Feb. 9-12.

American Society of Civil Engineers—Los Angeles Convention, Los Angeles, Calif., Feb. 9-13.

Pacific Coast Electrical Association — Business Development Conference, Hotel Sheraton-Palace, San Francisco, Calif., Feb. 12-13.

American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc—Annual Meeting, Hotels St. Francis, Sheraton-Palace, Sir Francis Drake, San Francisco, Calif., Feb. 15-19.

Electrical Trade Conference & Exposition — Sheraton Park Hotel, Washington, D. C., Feb. 17-19.

American Public Power Association—Engineering & Operations Workshop, Springfield, Illinois, Feb. 19-20.

• Additions this week.

Advertising Index

Acme Wire Co. 101
Allen-Bradley Co. 55, 56
Allis-Chalmers Mfg. Co. ..... 2nd Cover, 6, 7, 72, 149
American Pamcor, Inc. 123
Anaconda Wire & Cable Co. 141

Babcock & Wilcox Co. 12, 13
Bethlehem Steel Co. 111
Blackburn Corp., Jasper 64
Bodendieck Tool Co. 88
Bristol Co. 103
Buhrke Co., R. H. 70
Burndy Corp. ..... 3rd Cover, 127

C & D Batteries, Inc. 135
Cable Spinning Equipment Co. 88
Colorado Fuel & Iron Corp., Wickwire Spencer Steel Div. 71
Combustion Engineering, Inc. 32, 33
Condenser Service & Engineering Co., Inc. 134
Crescent Tool Co. 106

Dice Co., J. W. 70, 102
Directory of Engineers 151

Empire Metal Products Co. 114
Engineers, Directory of 151
ESCO Mfg. Co. 102

Fanner Mfg. Co. 65
Fargo Mfg. Co., Inc. 90
Federal Pacific Electric Co. 18
Fisher-Pierce Co. 69
Foushee & Heckendorn 68

G & W Electric Specialty Co. 63, 116
General Cable Corp. 67
General Electric Co. Apparatus Dept. 48, 49, 50, 51, 52, 53
Gentex Corp. 118
Grinnell Co., Inc. 78
Grip-Tite Mfg. Co. 88

Hercules Powder Co. 83
Highway Trailer Co. 87
Holan Corp., J. H. 113

I-T-E Circuit Breaker Co., R & IE Equipment Div. 30, 31
Indiana Steel & Wire Co., Inc. 66

Jenkins Bros. 109

Kaiser Aluminum & Chemical Sales, Inc. 16
Kearney Corp., James R. 92, 93
Kirk Dial & Crystal Co. 102
Klein & Sons, Mathias 119
Kuhlman Electric Co. ..... 4th Cover

Lapp Insulator Co., Inc. 96, 97
Line Material Industries 34

Milbank Mfg. Co. 100
Moloney Electric Co. 17
Multi-Amp Corp. 100

Ohio Brass Co. 23, 24, 25, 26, 81, 133
Okonite Co. 4

Pennsylvania Transformer Div., McGraw-Edison Co. 10, 11

RT & E Corp. 131
Radio Corp. of America 99
Riley Stoker Corp. 28, 29
Roebling's Sons Corp., John A. 104, 105
Rolatape, Inc. 120
Rome Cable Corp. 121

S & C Electric Co. 128, 147
Salisbury & Co., W. H. 118
Sangamo Electric Co. 9
Searchlight Section 150
Simplex Wire & Cable Co. 85
Subox Inc. 112
Superior Cable Corp. 132

Turner Electric Corp. 68

United States Rubber Co. 27
United States Steel Corp. Coal Chemical Sales Div. 8

Westinghouse Electric Corp. 14, 15, 58, 136, 142, 143, 144
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp. 71

York-Hoover Corp. 89

PROFESSIONAL SERVICES 151

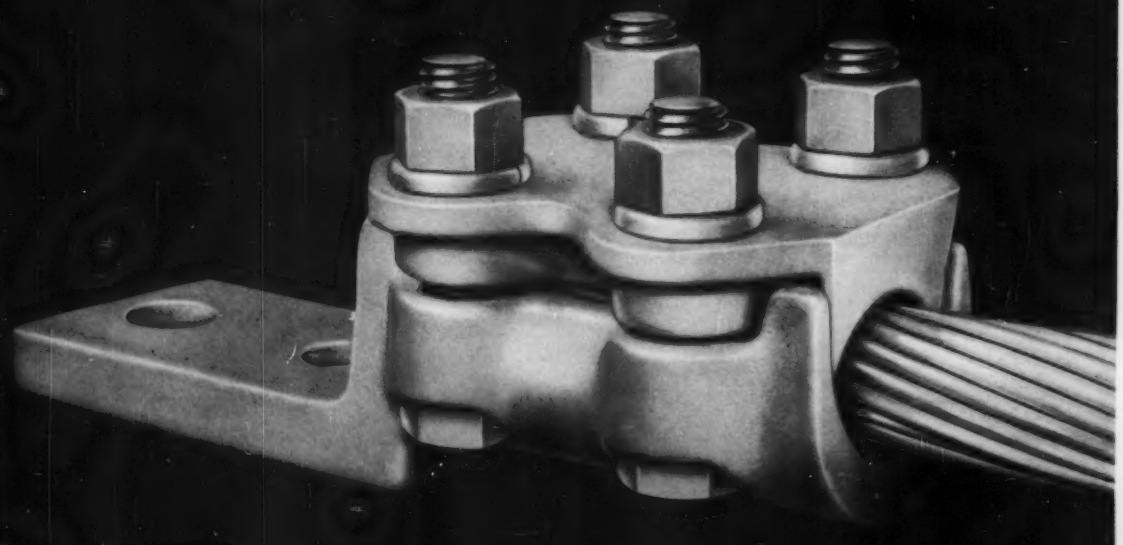
CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 150

EQUIPMENT (Used or Surplus New) For Sale 150

RANGE-TAKING TERMINAL

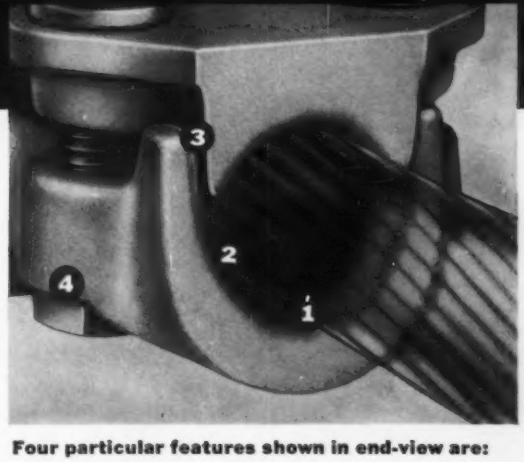
8 sizes install #8 thru 2000 MCM Aluminum or 1780 ACSR



Type NAR-A

Whether you are responsible for specifying, purchasing, inventory control or bossing a construction crew, the NAR-A line of range taking terminals is a line that can really do a job for you. It's a "clean", rugged, range-taking terminal that maintains a top performance record —up-and-down the cable ranges... up to 35 different cable sizes per connector.

The NAR-A does away with the old need of stocking a warehouse full or carrying a truck load of connectors. Eight sizes cover just about every cable size... #8 thru 2000 MCM Aluminum or 1780 ACSR.



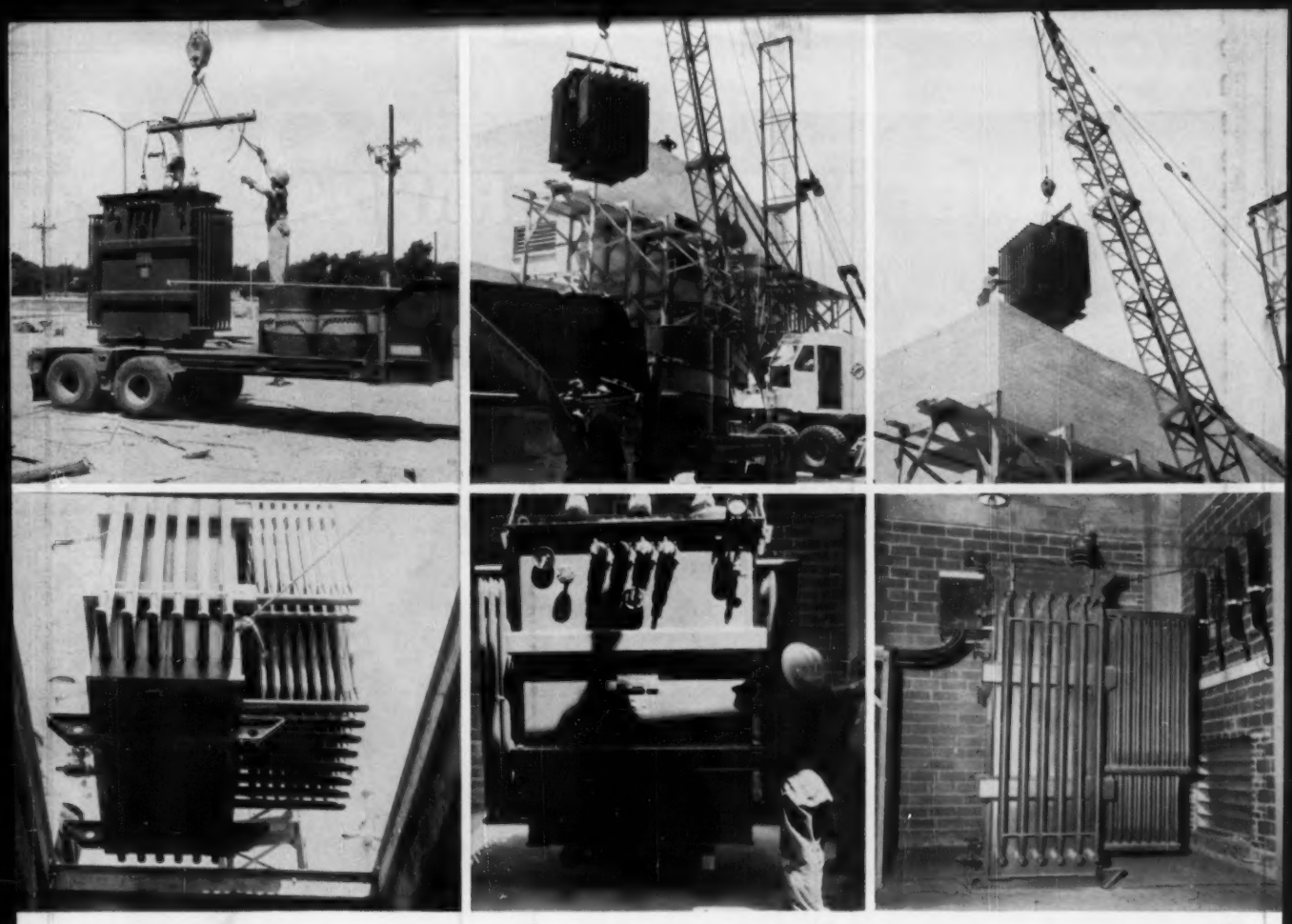
Four particular features shown in end-view are:

1. **Modified V-groove that assures good conductivity. Wiping action removes oxide film.**
2. **Wide belled cable entrances prevent cable chafing.**
3. **Interlocking tabs confine cables and prevent cable splaying.**
4. **Recessed bolt head pockets permit one hand installation.**

BURNDY

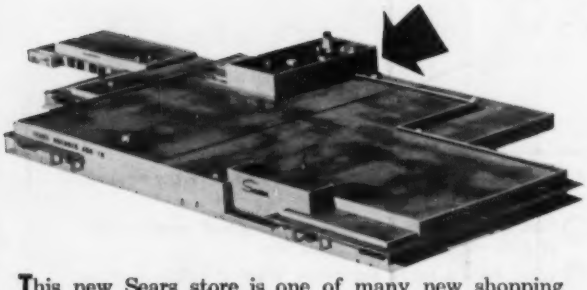
58-30

Norwalk, Connect. In Europe: Antwerp, Belgium Toronto, Canada



POWER ON THE ROOF INCREASES EFFICIENCY...

at Sears' new Amarillo shopping center



This new Sears store is one of many new shopping centers springing up in growing Amarillo, Texas. Following the modern trend, all floor space has been devoted to merchandise and display. Air-conditioning and operating equipment is installed on the roof—out of the way.

To put power where it was needed—on the roof to eliminate the losses and expense of long secondary copper runs—Southwestern Public Service Company selected Kuhlman. A regular user of Kuhlman, Southwestern knew from past experience that Kuhlman transformers would provide the required reliability. Then, too, like all Kuhlman customers, wherever they are located, Southwestern benefits from the close, friendly service of a nearby Kuhlman factory.

Whether it's distribution or power, for industrial, commercial, or residential use, you'll find Kuhlman transformers are designed to meet standard specifications as well as special conditions. Talk over your requirements with your Kuhlman representative. He lives in your area and knows your needs.

KUHLMAN POWER TRANSFORMERS

KUHLMAN ELECTRIC COMPANY General Offices: Birmingham, Michigan

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